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Reinventing indigenous knowledge : a crucial factor for an IPM-based sustainable agricultural development.

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REINVENTING INDIGENOUS KNOWLEDGE
A CRUCIAL FACTOR FOR AN IPM-BASED SUSTAINABLE AGRICULTURAL DEVELOPMENT

A Dissertation Presented

by

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DEDICATION

This dissertation is dedicated to my Mother Veronika Komi, whose vision, dedication and tireless support and love has made this high educational journey and achievement possible and kept me going this far in climbing this educational ladder. Although she never sat on any school bench in her entire live, her amazing vision about the power of education touched me deeply from earliest childhood and has motivated me to achieve the highest award of education.

I also dedicate this document to my father Matheus Bernard Moning who taught me to observe and record life as it unfolds before me and made it become an integral part of my own. He taught me that experience of life is the best guru in the whole universe.

For a project to succeed, local people must be involved, not just in supplying labor but in making crucial decisions. Projects must be based on people's own ideas and knowledge of their farming systems. Such an approach will change the ownership of projects from development agendas to the people. (Serageldin, 1994)

Ntombie Gata

Dr. Ntombie Gata was the Deputy Director of the Department of Research and Specialty Services of the Zimbabwe Ministry of Lands, Agriculture and Water Development.

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ABSTRACT

REINVENTING INDIGENOUS KNOWLEDGE

A CRUCIAL FACTOR FOR AN INTEGRATED PEST MANAGEMENT (IPM) - BASED SUSTAINABLE AGRICULTURAL DEVELOPMENT

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Indigenous farming communities in Indonesia and around the world have probably lived the way they always have: relying on the knowledge and skills they learned from their parents and neighbors. Indigenous communities are not static; they include inventors and innovators who bring changes into their communities. These inventions and innovations change the community's traditional practices and may spread to the neighboring communities.

The search for miracle seeds, begun in 1940's, was part of a major effort to fight world hunger. The dwarf Mexican wheat, for example, could produce quadruple the amount of harvest, and similarly the miracle rice seed—IR8—could

produce more than double the traditional rates of rice production, both with application of urea.

Using various credit packages as incentives and gimmicks, governments insisted that traditional farmers to change. They pushed the spread of high yielding varieties for “food security” reason. This explosion of yields later known as the “Green Revolution”

Since its inception in Indonesia in 1968, the Green Revolution quickly replaced traditional agriculture. In fact, it destroyed the existing sustainable system of Indonesian agriculture and replaced it with fuel-based agricultural system, heavily dependent on manufactured chemicals. Under the iron fist of their government, indigenous Indonesian farmers were forced to adopt this new and modern system of agriculture with the single-minded goal of maximizing the country’s food production, so there would be enough food to feed the nation.

In 1989, the United Nations Food and Agriculture Organization (FAO) introduced the Integrated Pest Management (IPM) program. IPM trained farmers to observe and collect field data and conduct agro-ecological system analyses. IPM training prepared farmers to think critically and to make smart or informed decisions about their crops. IPM was the gateway to this new world of knowledge for the farmers. Geared towards restoring the farmers’ ownership of knowledge, Farmers Field School (FFS) became an eye-opening experience for them.

Indigenous knowledge and sustainability had always gone together and had almost become a unity. Traditional agriculture based on indigenous knowledge and subsistence practices of native people had became an inseparable unity that helped sustain farmers through difficult times.

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CHAPTER 1

THE REALITY OF INDIGENOUS KNOWLEDGE

Introduction

I would like to share the story of Timorese farmers who prepare their paddy fields by using water buffaloes to trample the land. This is a story about how farmers in Timor prepare their rice field using water buffaloes to walk back and forth over and over the field in order to make it arable for their rice crop. This Timorese land preparation technique differs significantly from the more common land-preparation technique in many of the western part of Indonesia, mainly in Java and Bali. Javanese farmers use a manual plowing technique, requiring an animal, namely, water buffaloes and cattle, for draft and wooden plowshares strengthened with a steel-share at the plowshare tip.

Timorese farmers continue to use this technique of soil-preparation for paddy rice even after the introduction of a new soil preparation technique by the East Timor Agricultural Development Program (ETADEP). In contrast to the traditional method, ETADEP utilized heavy agricultural equipment for land preparation to reclaim 3,200 hectares of target area for conversion into productive paddy fields. It was this experience, among others, that led me to realize the necessity for development projects to recognize, respect and the include Indigenous Knowledge Systems (IKS).

The traditional Timorese method for soil preparation is very simple, yet involves a number of social and cultural practices. Traditionally, Timorese farmers used water buffaloes to trample their rice fields in order to prepare the soil for rice cultivation. This method, locally known as *sama-natar*, is common in many parts of eastern Indonesia. Farmers arrange the use of buffaloes with the buffalo owners. In Timor, buffalo herds are owned, in large part, by the local aristocrats, the raja or *liurai* (the chief of the land), who customarily receive a 50% share of the harvest in exchange for the service. Depending on their area availability and the size of land being prepared, a group of five to one hundred buffaloes are used in trampling the field. For a small plot of 1,000 square meters, five to fifteen buffaloes are normally sufficient. A larger piece of land, one-half acre to a hectare, might require as many as fifty to one hundred buffaloes.

Soil preparation can occur only during the rainy season, which normally runs in Timor for about three months (i.e., from November through January). The process begins when water from the river or traditional irrigation canal is channeled into the fields. The water makes the soil softer, a preferred condition for buffalo trampling. Buffaloes' hooves crush the grass and mix it with the soil. The grass stems crushed by the buffaloes usually decompose quite easily. The farmers then wait for one to two weeks before running a second round of trampling to make the plot ready for rice cultivation. This completes the traditional soil preparation for paddy rice.

Farmers and the entire village community celebrate by a "washing of the buffaloes' feet," a festive communal party to give thanks for the successful soil preparation and to pray that the god(s) of land will bless them with abundant harvest. From this point on the farmers follow a meticulous process to grow the rice. Farmers and their family members take care of seedbed preparation, seedling transplantation, weeding, irrigating the plot, deterring the birds, and ultimately harvesting and storing the grains.

In an effort to increase national agricultural production dramatically, the Indonesian government imported outside technologies and expertise. The ETADEP project was located in the Loes river basin and included many villages in sub-districts of Hatolia, Kailako, Atabae and Maubara. Farmers' participation was mandatory in this centrally controlled program, so participating farmers received one hectare of lowland area per family to plant paddy rice. Lured by incentives, such as free soil preparation service using tractors, seeds, and fertilizers, farmers became attracted to the program. People in the local communities were initially excited about these technologies because they were free of charge or subsidized by the government.

Prior to the program's arrival, the land had been abandoned and was covered with wild-cane grass (*Saccharum spontaneum*), a type of grass that grows to a height of 9 to 15 feet and anchors its roots about one foot or deeper into the ground. The program utilized a rotary-blade to cut the wild grass, which mowed and cleared the land surface, leaving about one quarter foot of grass remnants above ground. Then, the soil was turned over using a heavy-duty disc-plow. The deep roots of wild-cane grass were uprooted and the cutout grass chopped and mixed with the soil. If the land was dry, irrigation water was brought into this area by tractors attached with rotary tillers. The land was turned into deep muddy soil. In order to optimize the project service coverage during these rainy months, all twenty-two of the project's tractors were working approximately twelve hours per day with tractor drivers working in two shifts. This completed the soil preparation phase for the wet land rice. It was then up to the farmers to continue the rice growing sequences through to harvest-time.

As part of the project's strategy to prepare farmers to take over the cost of soil preparation, the project expected farmers to co-finance the soil preparation costs when the project was nearing completion. Based on cost calculation at that time, farmers needed to contribute about US $60 per hectare to cover the cost of the fuel alone. In a place where a farmer earned only about two dollars for a day of labor, farmers simply could not afford such a high price for soil preparation. Besides, cash was also hard to get in the rural areas. Farmers had no other option but to go back to the old system of trampling with water buffaloes to prepare their soil for rice cultivation.

These two different techniques of soil preparation produced two different results. Using heavy-duty machinery, the project could quickly clear a large land area. However, land prepared using tractors had serious weed problems from the beginning of the rice cultivation. Mechanically chopped wild-cane grass made clean cuts of the cane grass that could easily reproduce new growth. These shoots of grass grew fast outpacing the growth of the rice plants, becoming major competitors of the rice crop for nutrients. Consequently, fields like this produced poor harvests. Weed-ridden rice fields were also difficult to harvest, as grass-covered fields hid the rice crop.

Meanwhile, the traditional trampling method using water buffaloes better prepared land for rice cultivation from the start. The traditional technique integrates crushed and decomposing grass stems into the soil as green manure. This adds nutrients to the soil and controls the weeds. In Timor, where labor is scarce, this is an efficient technique, because weed control is done in early stages of farming activities (i.e., during soil preparation). In the end, the traditional method better prepared rice fields without grass problems to provide an excellent environment for the rice crops.

Initially, imported and advanced technologies brought in to address local problems seemed to offer cost-effective solutions to local farmers. Nevertheless, the government did not consult or involve local farmers in such an important decision-making process that would determine their farming practice. When the farmers had to pay the full cost, these technologies became unaffordable, especially when the cost was coupled with doubtful effectiveness and reliability. Thus, this approach had proven unsustainable to the local or indigenous communities. Local or indigenous practices, on the other hand, suggested affordable options and offered lower-risk operation. The water buffaloes trampling method had proven to be a simple, affordable, and reliable farming method for Timorese indigenous communities.

Statement of Problem

In a broader sense, development projects aimed at improving, benefiting, and sustaining local communities, often fall short of achieving stated purposes and goals. The primary reason for this failure is the projects' inability to bring these local communities to a new level of self-sustainability. Sustainability means the ability of a community to continue the introduced practices and to support them with their own resources after the sponsor who originally supports the program left the area. Examples of such development projects include agricultural development, health and sanitation, childcare and nutrition, drinking water sanitation, income generation, family planning, and many other projects with the purpose of improving the living conditions and livelihood of the poor. It is important to check the validity of development projects from the beneficiaries' perspective by raising the following questions:

- Are these projects successful?
- How do we measure the degree of success from the beneficiary point of view?
- Are projects then over when all activities end and all funds are finally spent?
- Project reports are written in order to show positive changes happened in the life's quality of the people. Do these people continue to reap these benefits through their own efforts as the result of their involvement in project?

Most projects mention sustainability as an important indicator of success. However, often these projects are incapable of demonstrating that they are able to bring people to a new level of sustainability. Problems related to incapability to pursue, achieve, and maintain sustainability level is intrinsic to many development projects.

Failures of Development Projects

Failure to Recognize Indigenous Technologies

Many development projects aimed at benefiting communities rely heavily on the transfer of technologies. These projects fail to understand the crucial role of indigenous knowledge system. These knowledge systems have existed in these communities long before the introduction of development projects. In order to achieve a viable level of sustainability, it is necessary to link introduced technologies with technologies currently practiced in these communities. Many projects ignore the importance of creating these links. This failure of linkage creates major gaps between the introduced technologies and the local, self-sustaining, technologies based on the existing indigenous knowledge system, which in turn leads to discontinuation of introduced technologies in the local communities.

Failure to Respect Indigenous Technologies

To a certain extent development projects presume that indigenous technologies did not exist or were inferior compared to the new, outside technologies they brought in. This presumption results in the disregard of indigenous technologies. Ignorance of the existence of indigenous knowledge—a knowledge that has assured the survival of these communities for generations—can result in backlash effects. This particularly applies to the technologies introduced by using incentives to entice community members into participating in a program that they would otherwise have avoided.

Imposition of Foreign Technologies

Development projects should try to build a strong community base for the introduced knowledge system in the targeted communities during the project's duration. This knowledge system is external and foreign to these communities. First, it is impossible to create a strong base for external knowledge system in a short time period. Secondly, the construction of a new knowledge base system in the local communities would require intensive education and training strategies. Further, these introduced knowledge systems need to prove their applicability and potential to benefit the community.

Self-Serving Foreign Technologies

Often, technologies introduced to local communities serve, mainly, the goals and purposes of external entities such as government, non-government organizations, and private sectors. These organizations function mainly as service delivery organizations. Their programs are dependent on contracts provided by funding agencies. They strive to complete contract as stipulated by the donors. Although their stated purpose is to serve and to benefit these local communities, they tend, in reality, to become the tools for supporting these external entities rather than addressing the true needs and purposes of the communities they served.

Lack of Planning for Technological Maintenance

Transferred technologies are expensive at all stages (i.e., during the introduction, the execution, and the maintenance of these technologies). Operational costs of these technologies and the maintenance to upkeep of the equipments are prohibitive; therefore, the program's sustainability ceases when imported machines or equipment break down. The communities may lack the money for repairs or their capability to access the necessary spare parts for the broken machines. For example, should a mini tractor donated to an isolated community through an agricultural program need a new water pump, or new propeller belt, or the rotary blades need sharpening, there was neither repair shop nor parts available in close proximity. Spare parts might have to come from the big cities or imported from the country of origin.

This situation results in communities' dependency on outside help. Communities have to request successive extension of the project, which in turn delays the community's attaining control of these projects and technologies. Lacking the skills or the will to proceed independently are the main causes for introduced programs' failure to ensure community achieve the new sustainability level with the introduced program.

Thesis Statement

Recognition, respect, and the inclusion of the Indigenous Knowledge Systems (IKS) are crucial for the sustainability of a community. Therefore, every new development project should clearly enter in conforming attitude of the above approaches towards IKS. Development projects based on Indigenous

Knowledge (IK) of the communities they serve will create a solid foundation of continued interest in and sharing of innovations, thus improving the beneficiaries' control of their knowledge and livelihood. This study on the farming communities in Central Java, Indonesia that participated in the Integrated Pest Management (IPM) program provides support for the above statement.

Necessary Attitude towards Indigenous Knowledge Systems

Recognition

Indigenous Knowledge Systems are difficult to recognize because they blend smoothly into the community's daily activities. In Central Java, sharing of Indigenous Knowledge is primarily in spoken form. It rarely exists in recorded form such as books or comparable media. Indiscernible to outsiders, the community perceives its existence within their own circle. Indigenous Knowledge is the social fabric of the community's life, which motivates and inspires its members to continue its practices and traditions

Respect

Respect to Indigenous Knowledge is linked to the community's preferential value of their own knowledge. Since indigenous knowledge is crucial to the community's survival, disrespect to IK may create resentment in the community. Indigenous communities expect members and non-members to respect to these values. In case of a violation made by a member of the community, the community will simply ask the person who rebelled to comply with these community values and/or pay fines as previously agreed among them. If the non-members do the violation, the community might do similarly or ask the violator to leave their community.

Inclusion

The inclusion of Indigenous Knowledge systems in development projects, especially in interaction with exogenous knowledge systems, gear up community members to recognize the importance of learning. It is crucial for the community to educate themselves about new commodities or skills needed. This inclusion helps expand the community's knowledge base in conjunction with their own indigenous knowledge.

Solid Base for Sustainability

Indigenous Knowledge systems form the foundation that nurtures the development of knowledge in Indigenous communities. Introduction through dialogue is crucial for an exogenous knowledge system to become an integral part of the indigenous knowledge systems and technologies. Thus, integration into the existing knowledge makes it inseparable from the community's daily practices; otherwise, it may be lost and forgotten. Thus, it will become unsustainable.

Exploration of Further Innovations

The dynamics of the Indigenous Knowledge system can be found through the exploration of further innovations. Although invisible to outsiders, this dynamic, the inclusion of the exogenous knowledge system within the Indigenous Knowledge system, excites the community. Newly acquired knowledge stimulates the community's curiosity and expands their knowledge acquisition.

This non-intrusive knowledge integration process would encourage further expansion of the indigenous knowledge.

Integrated Pest Management

IPM is an agricultural program sponsored by the United Nation's Food and Agricultural Organization (FAO) to promote ecologically balanced farming activities. IPM encourages farmers to apply environmentally friendly practices in order to achieve optimal agricultural output. IPM focuses on minimizing chemical inputs, mainly pesticides. Farmers are encouraged to consider ecological impacts of their farming methods, especially by promoting pest control using natural predators of the pests. Minimum use of pesticide or no pesticides application encourages natural propagation of pest enemies and creates a balanced equilibrium between their crop and its surrounding environment. In the end, these methods contribute to the increasing agricultural productivity, as well as to reducing toxic pollutants from modern agricultural technologies.

The program also works to develop farmers' farm management skills by doing field observation and conducting agro-ecological analysis. That way IPM farmers' decision become a well informed decision based on the facts they collected from their own field-crop.

Sustainability is crucial because participating farmers who adopted the concepts needed to continue and make improvements in their lives.

Respect and inclusion of the agricultural indigenous knowledge contribute to the community members' active involvement in the programs. People increase their contributions in the process by applying their own initiatives and working to integrate the acquired knowledge with their own knowledge. Participating farmers play the central role in the knowledge transfer as they achieve recognition in cooperatively furthering their knowledge to improve their quality of life. Participating farmers become motivated, improve their self-confidence, increase their curiosity in new knowledge, and recruit their neighbors into this ever-improving process. The success of the hybrid technologies is evident in the improved agricultural practices and results in the improvement of the people's livelihood in these communities.

Purpose and Goals

The main purpose of this dissertation is to show that Indigenous Knowledge plays a crucial role in the sustainability of development program. In light of the IPM experiences, the following three goals explain why it is crucial for achieving of the above purpose:

1. Acknowledge the crucial role of the Indigenous Knowledge System in the success of Integrated Pest Management (IPM) agricultural development program. In Indonesia, the government previously discouraged and banned these traditional agricultural practices. Farmers who participated in IPM program activities revived an organic farming system by revisiting, reviewing, and renovating these indigenous traditional practices.
2. Record and share a number of Indigenous Knowledge Systems and local practices studied in various agricultural communities. This modern record in the written format will preserve and disseminate the knowledge itself. This format will be available in print and electronic documents.

3. Advocate the renaissance of Indigenous Knowledge Systems beyond agriculture boundaries to many other areas of development that influences the livelihood of local communities around the world. Accomplishment of this purpose will be achieved through inventorying, cataloging, and sharing the knowledge among members of the community as well as with members of other communities. It goes beyond cultural, social, ethnic, and national boundaries.

The Study

This study focuses on Indonesian agricultural communities, primarily in the Central Java province. These communities had lost their indigenous agricultural practices, because of government imposed, national scale agricultural programs, and known worldwide as the Green Revolution. The study shows how the Integrated Pest Management (IPM) program revived the Indigenous Knowledge System and traditional agricultural technologies and practices by providing alternative approaches. The IPM program intended to help farmers become aware of the agro-ecological relationships of their rice crops in order to produce high yields of healthy and environmentally safe food for the nation. The study focuses on IPM's educational approach that liberated farming communities as they became critically aware of their farming practices and moved themselves away from practices that are detrimental to their health and the environment.

The researcher's previous involvement in a number of agricultural programs and community development projects in Indonesia and East Timor on issues of promoting sustainable agriculture had much influence on this choice of study topic. Chapter 3 of this dissertation will thoroughly discuss methodology of this study; which include the purpose of study, research questions, how to conduct the study, location of the study and data collection and data processing techniques.

Theoretical Concepts

Importance of Indigenous Knowledge System Development

Development is a conscious effort of local or international governments, non-government organizations, and private sectors to improve the living conditions and quality of life for people in (poor) communities. Most of these organizations operate from outside of the communities. Many development programs often involve in remote planning—disengaging of community's involvement—which sometimes strictly imposed these plans upon communities despite frequently being incomprehensible and unmatched to their indigenous needs, perceptions, and preferences.

Indigenous knowledge forms the basis of a community's customs and the reference point for their beliefs and practices. A definition as described by Michael Warren (Ed.) in his book *The Cultural Dimension of Development - Indigenous Knowledge System*, published in 1995:

> Indigenous Knowledge (IK) is local knowledge - knowledge that is unique to a given culture or society. This is in contrast to the international knowledge system generated through the global network of universities and research institutes.
> IK is the basis for local-level decision-making in agriculture, health care, food preparation, education, natural resource management, and a host of other endeavors in rural communities (Warren, 1995, p. 426).

Havekort defines IK in his article published in the similar book mentioned above as follows:

> Indigenous knowledge is the actual knowledge of a given population that reflects the experiences based on traditions and includes more recent experiences with modern technologies. Local people, including farmers, landless laborers, women, rural artisans, and cattle rearers, are the custodians of indigenous knowledge systems (Haverkort, 1991 in Warren, M. D., 1995).

While Warren emphases the contrast between indigenous knowledge and external knowledge systems, Haverkort believes, external knowledge and technology can be included in indigenous knowledge systems. This shows Haverkort is aware that IK is not a closed system that isolates itself, but rather communities are willing to interact with the outside world and open to learn new ideas. IK is not static; it has its own internal dynamics and progress shared within the community. Indigenous communities are well informed about their own situations, their resources, what works and do not work, and how one change effects other parts of their system (Butler and Waud, 1990).

Mundy and Compton elaborate, adding that communication is an important part in the process of forming and influencing this knowledge. Most definitions of Indigenous knowledge refer to the accumulation of experience and the passing down of information from one generation to the next within a society. Yet, despite frequent expressions of concern for enculturation, little attention has been given to how knowledge is accumulated and shared within local societies. Communication is one of several processes essential for the continuity and spread of knowledge and the culture in which it is embedded (Mundy and Compton in Warren, M. D., 1995, p. 112).

In the above statement, Mundy clearly differentiates between the accumulation of knowledge and how that knowledge is communicated. The way members of a community gain and accumulate knowledge shows how they perceive and value that knowledge. Knowledge shared among members are knowledge proven useful to the community and helped them survive. Community members share their knowledge through the process of interaction. Sharing of knowledge could also happen with members from outside of their community.

Another definition of Indigenous knowledge, as described by the International Institute of Rural Reconstruction (IIRR) expresses the following ideas.

> Indigenous knowledge is the knowledge that people in a given community has developed over time and continues to develop. It is:
>
> - Based on experience
> - Often tested over centuries of use
> - Adapted to local culture and environment
> - Dynamic and changing (IIRR, 1996)

Indigenous knowledge is not confined to tribal groups or the original inhabitants of an area (called indigenas in Latin America). It is not confined to rural people or people living in isolated locations. Rather, any community possesses Indigenous Knowledge, rural and urban, settled and nomadic, original inhabitants and migrants. Other names for Indigenous Knowledge (or closely related concepts) are "local knowledge," "indigenous technical knowledge" and "traditional knowledge." (IIRR, 1996, p.7) According to IIRR, Indigenous Knowledge often contrasts “scientific”, “western” and “international” or even "modern" knowledge developed using formal scientific approaches, commonly applied by universities, research institutions and private companies (IIRR, 1996).

Indigenous knowledge is knowledge within a society that is passed down from one generation to another, from one community to another, from one individual to another in the society. This mainly oral and locally generated knowledge is specific to the cultural heritage and living conditions and is maintained within a certain group of people. This definition intentionally broadens the term "indigenous." For example, a family living in modern New York City still owns and maintains its Indigenous knowledge system throughout their daily lives. This sharing of tradition and cultural heritage constitutes the transition of ethnic food preparation, treatment of minor illnesses, behavioral customs, family values, and belief systems. Thus each family and community form a part of the Indigenous Knowledge Systems. Indigenous knowledge is not merely the knowledge of indigenous people (IIRR, 1996).

In addition, Indigenous knowledge systems are not location specific, but rather to community's intrinsic characteristics. For example, a group of Eskimo families living in the heart of modern life of New York City could apply their indigenous medicinal practices for curing illnesses among their family members. If these practices are beneficial in improving health, their non-Eskimo neighbors might also come for help and adopt that knowledge.

The broader definition of the Indigenous knowledge, although less related to this study, clarifies how indigenous knowledge interacts with and taps into information from other sources or knowledge systems; how it incorporates new ideas and practices through its own research and explorations. This definition explains how the learning cycle and the internal dynamics continue endlessly.

Indigenous knowledge is not static, but rather is teeming with internal dynamics, external interaction, and is adaptive to change. A young Eskimo man who moves to New York City, then later decides to move back to his Alaskan home, brings with him the substantive knowledge he had acquired while living in New York that he will share with his Alaskan community. If he makes his community's progress known to the world via the internet, the cycle continues. This illustration is also comparable to Japanese during the Meiji periods who explored and adapted to knowledge from the West in order to improve and upgrade their nation, while maintaining their traditional values. As later depicted in Quadrant D of *Mundy-Compton Windows of Knowledge,* communities proactively explore options for improvement.

Further, community interaction with outside agents recognized through various means of communication or channels. Internal knowledge transfer within the community may include story telling, folk media, and community or religious meetings. External knowledge may comprise radio, television, printed media or organized meetings with extension agents. Within the indigenous community, Mundy and Compton identified at least six different channels of knowledge transfer within the community.

Indigenous Communication Channels

Mundy and Compton in one of the article of *The Cultural Dimension of Development* - Indigenous Knowledge System, edited by Warren, Michael in

1995, identified six different indigenous communication channels. These are: folk media, indigenous organizations, deliberate instruction, records, unorganized channels, and direct observation. Members of the indigenous community commonly use these indigenous channels, along with symbols and gestures. They are explained as follows:

- Folk Media

This broad-range art form is the indigenous equivalents of exogenous mass media. Besides being primary used for entertainment, they also promote education and values in the context of cultural continuity. Folk media includes festivals, plays and puppet shows, dance, song, storytelling, poetry, and debates.

Indigenous organizations and Social Gatherings

This includes religious groups, village meetings, and irrigation associations such as Balinese *subak,* mothers' clubs and loan associations. Saving pools or arisan where members put small amount of money on weekly or monthly basis and draw a winner—only once in a cycle—who then collect the pool money. This saving pool activity will end when every members has the turn to win. Communications normally transmitted through formal member meetings, notices about activities and obligations, and through daily work-activities are also included.

- Deliberate Instruction

Deliberate instruction is an institutionalized act or set of acts performed by one individual to modify the behavior and induce habit formation of another individual. Many traditional Koranic schools and madrasah spread all over

Indonesia are examples of deliberate instruction. This accounts for a large part of the enculturation process, including both directed learning, “informal acts of teaching,” and schooling, “formalized institutional activity… found only in literate societies” (Warren C. P. 1964: 3-4).

- Records

Another way of communicating indigenous information is through written, carved, painted or memorized records. Examples of these formal records include the South Asian treatises on animal management written on palm leaves, ancient scripts on *bai lan* or *lontar* leaves preserved in Thai Buddhist temples and in Hindu temples in Bali, and similar leaves containing records of land ownership and tax obligations (Gertz 1980:179). Often, records are not in written format. For instance, African storytellers narrate memorized historical epics. Genealogies, proverbs, and folklore are other vehicles for transmitting cultural information.

- Unstructured Communication Channels

Unstructured communication channels happens in the conversation at home and at the well, in the fields and on the road, in the teahouse and coffee shop, in the chief's house and at the market, and wherever else people meet and talk is spontaneous and informal. Folk media and indigenous organizations provide many opportunities for such unstructured communication.

- Direct Observation

Direct observation does not have to be intentional. A farmer can conclude from another’s bumper crop that the employed technique is good. Pak Oyo story listed in Appendix C about practicing IPM by inviting dragonflies, a predator to Brown plant hopper by putting bamboo sticks simply by observing that sharp or pointed objects in the rice field attracts dragonflies to sit on it. The source does not have to be a person. Dark cloud alerts farmers of a coming thunderstorm as clearly as another person could.

- Symbols and Gestures

Symbols and gestures also play an important part in indigenous communication. Many indigenous communication specialists, like Mundy and Compton, might not include these symbols and gestures because they are invisible to the outsider. They are, however, very significant in the indigenous community's life and practices. The traditional *slash and burn* agricultural practice explained below, illustrates how symbols and gestures play important roles among indigenous communities.

Indigenous Timorese farming communities practice slash and burn, a primitive technique of crop growing in a forest canopy or bush covered area. The use of axe and fire are common for land clearing. After the trees fall, farmer burns forest debris, leaving the ashes, rich in nutrition, to fertilize the crops they will plant. Farmers plant their crop using wooden sticks to make holes where seeds are inserted. After about three to four years of sequential planting seasons, soil fertility eventually declines. When a communal land loses most of its nutrients, people in the community cleared new land in order to prepare for the next cultivation. The exhausted land is given a fallow period so the soil can recuperate and become arable again. This period may last a couple of years.

With a ceremony of hanging animal feet at the entrance to this land, which symbolizes the closing of the gates to this area, the community declared the overly used land area closed to community's access. Any community member who violates this symbolic agreement would face community charges and fines. In some parts of Timor, violators must provide and finance a feast, comparable to the one for closing the land, for the whole community.

During the ETADEP project period (1980-1985), government agricultural extension agents instructed farmers to replace their local preferred variety of rice with, IR5, a hi-yielding rice variety from IRRI. Agricultural agents interpreted Farmers' head-nod when listening to the instructions as acceptance. Though, in reality, the farmers did not easily follow outsiders' instructions. They conducted their business as usual. Whereas head nodding in Indonesian culture symbolizes agreement, at that particular time, one must interpret it differently. For Timorese farmers whose country was then under the Indonesian military occupation, they were afraid of expressing of disagreement about a government program in a public meeting. In many Asian communities, it considered rude to express open disagreement with outsiders, i.e., the government representatives or officials from the district office. Therefore, the gesture of nodding the head may not necessarily express an agreement.

Among indigenous communities, symbols and gestures play an important role in communication and thus must be recognized and understood. Unspoken language in many cultures, modern cultures included, such unspoken communication often carries a stronger message than the spoken one. One should recognize the non-verbal language, hidden and delicate, expressed through signs, gestures and mimic expressions.

Knowledge and Communication Systems

Theoretical concepts of communication developed through differentiating the interface between knowledge systems and communication system, around Mundy and Compton ideas (Mundy and Compton, 1995). Communication, the process of passing and sharing information or knowledge, translates to the core element of education. The concept of education through communication becomes even more significant when applied to adult learning. Adults learn better through interaction, which is a form of expressed communication than other learning methods. It is important to recognize the concept that expressed communication is education and vice versa. Throughout this dissertation, readers will find the concepts of communication and education interchange.

The *Mundy-Compton Windows of Knowledge* matrix illustrates the interchange between knowledge and communication systems by recognizing both internal (indigenous) and external (exogenous) knowledge systems. This model displays the interception between Exogenous Knowledge systems, also known as western or universal knowledge, and Indigenous Knowledge systems. The following table depicts possible outcomes that could occur when knowledge systems, both indigenous and exogenous, encounters indigenous and exogenous communication systems.

Table1. Mundy-Compton Windows of Knowledge

Communication Systems	knowledge Systems	
	Exogenous	**Indigenous**
Exogenous	Quadrant A: Technology transfer	Quadrant C: Indigenous knowledge-based development
Indigenous	Quadrant B: Diffusion; co-optation of traditional media	Quadrant D: Cultural continuity and change

(Mundy and Compton, 1995)

The four windows or quadrants that map the interactions between knowledge system and communication systems are describes below:

Quadrant A

This quadrant represents technology transfer as the result of exogenous communication, or an indigenous community's adoption of foreign technologies, practices, and information. The assumption that this knowledge is superior to the indigenous community's knowledge, technologies, and practices is a widespread myth among many development specialists who believe that the improvement of a community's livelihood can only come about through the transfer of technology.

This dissertation challenges quadrant A viewpoint. Technology transfer can only succeed when factors of the transferred knowledge—related to the technology—are harmonious with the knowledge existing in the indigenous community and thus, improved by it. Without this match, efforts for technology transfer are futile. The introduction of latrines to promote health and sanitation program were difficult to many traditional villages whose members' squat everywhere. People have no concept to contain health hazard in one place and should avoid fecal contamination from all body of water. Once this people understand that feces are health hazard they will change their perception about latrine and may change their life style by adopting latrine as a part of their life.

Quadrant B

In this quadrant, diffusion refers to conveying exogenous knowledge using traditional media. The purpose of using this type of communication is to introduce exogenous information to indigenous populations. This approach, a favored practice of many governments, uses of propaganda as a persuasion technique to promote development programs to sell exogenous knowledge and technologies is predominant. One such example is the use of shadow puppet theater to convey family planning messages. Community members recognize the propaganda and reject the exogenous knowledge or technology. Co-optation of traditional media puts the media and performers at risk of losing their ingenuity and popularity among their audiences.

Quadrant C

This quadrant refers to the use of exogenous communication methods to portray Indigenous knowledge. External documentation efforts provide viewpoints of the ongoing realities and dynamics within indigenous communities. This communication primarily targets the outside world to educate exogenous communities about indigenous communities and their internal dynamics of the indigenous knowledge systems. Researchers, Universities, and Research centers are the main representatives of this quadrant. Such efforts have documented and saved many valuable indigenous knowledge systems that would have otherwise been replaced by external knowledge systems. Many indigenous communities were not able to resist modernization process critically; as a result, they abandoned their indigenous knowledge with those from outside. This dissertation, written with the purpose to recognize IK values, preserves, and advocates for Indigenous communities and their knowledge about agriculture, their environment, and livelihood. Therefore, it falls into this category.

Quadrant D

The cultures of indigenous communities continually change and evolve because of the community's communication about their knowledge, technologies, and practices. This is a continuous process that takes place prior to and regardless of with or without intervention or contacts with exogenous communities. Mundy and Compton clearly state that changes happen continuously as part of internal dynamics of the indigenous communities. For the untrained eyes of outsiders, small but significant changes taking place within the indigenous communities are invisible. Thus, mistakenly, outsiders perceive the community's ongoing dynamics as static.

Why is the Indigenous Knowledge System crucial?

Many development specialists assume Indigenous knowledge, despite its reliability, affordability, and sustainability, is inferior and, therefore, unsuitable for their purposes. Many development projects aim to replace Indigenous knowledge with the exogenous knowledge they are introducing. Instead of replacing one knowledge system with another, which takes time and is often doomed to fail, they could integrate and assimilate Indigenous knowledge with introduced knowledge to create a mixture of knowledge, suited for the community. This hybrid knowledge maintains community ownership and control and has the necessary adaptations for improved performance better results.

Maintaining the ownership of Indigenous knowledge is crucial for sustaining its continuity within the community. Expansion of this knowledge may be achieved through dialogue, discussion, and decision making processes. Introduction to change needs to be made through education and the process of critical thinking, not through force or intimidation.

The Challenges and the Merits of Indigenous Knowledge System

Countries' governments believe that products of exogenous or western knowledge are superior and readily to embrace it. For example, 'magic' rice seeds (IR5, IR8, IR36 and IR64) were developed in a modern laboratory at the International Rice Research Institute in Los Baños, Laguna, the Philippines through a rigorous scientific selection process. The IRRI guaranteed better yields, higher pest resistance, drought resistance, and so on. IRRI believed these seeds could grow anywhere in controlled lab-like conditions. Yet, no farmland could replicate the laboratory conditions at an affordable cost. Consequently, the 'magic' rice seeds would not perform well when planted in farmer's rice fields, not in Java, nor any other place around the world.

In the late 1960s, Indonesia, like many other developing nations, joined the Green Revolution program promoted by donors from a consortium of members from developed nations. The main purpose of this program was to increase the nations' food productivity by importing advanced agricultural technologies and providing loans to foster the communities' food independence from outside sources. This has become an attractive proposition for many developing nations' leaders and policy makers throughout the world. Bilateral and multilateral funding and the largest financial institutions funded these programs: The World Bank and The International Monetary Fund.

In the developing countries, the Green Revolution aimed to increase farm productivity by applying modern agriculture technologies. Based on the acreage of their cultivable land, farmers received credit packages that provided high yield seeds, fertilizers, pesticides, and even some cash credit to pay for the labor. Later on, the program added plant growth hormone and herbicides too. In Indonesia, farmers' participation was mandatory; the government instructed farmers on how to go about their farming activities.

The Green Revolution encountered many serious problems such as farmers' resistance to change and the necessary support of infrastructures required for optimum agricultural results. Some of the vital infrastructures required are:

- Technical irrigation system that can provide year-round water
- Good road and transportation to ensure timely supply of agricultural inputs
- Post-harvest processing and storage facilities
- Marketing system to sell produce

Without proper infrastructures in place, agricultural inputs such as seeds, fertilizers, and pesticides were often inaccessible to farmers. The following illustration shows the significance of good infrastructures in a project's success.

Sharing the East Timor Agricultural Program (ETADEP) experience on untimely delivery of Urea fertilizers from the Department of Agriculture (DOA) to the Timorese farmers participated in the ETADEP agricultural project.

In Timor, Urea, a nitrogen-based fertilizer, is needed at the beginning of planting season in November. Farmers participated in the ETADEP agricultural project were to receive Urea from the Department of Agriculture (DOA). In September, the project administrators calculated the amount of Urea needed and requested the fertilizer from the Provincial Agricultural Office. This request was then passed on to DOA central office in Jakarta, the capital city, where the fertilizer usually sent immediately, depending on the supply in central storage and the shipping schedule. Assuming there would be no problem in shipment, the fertilizer was to arrive in Dili, the capital of East Timor, in November. However, this was the start of rainy season and roads from Dili to Sare, the project base-camp, were muddy and often inaccessible due to fallen trees, landslides, and flooded rivers. It could take weeks for delivery. Upon arrival at the project's base-camp, distribution to farmers would take an additional number of days. Meanwhile, farmers have already planted their rice crop and the crop would have grown past the vegetative growth period, the season ideal for nitrogen application.

Indigenous agricultural practices are independent of outside resources such as inorganic fertilizer, pesticides or super seeds. Instead, they rely on available resources that have proven over generations to be self-sustaining. The practicing community as being self-sustaining only recognizes the value of the

Indigenous knowledge system. Agricultural techniques, traditional medicines, preservation their natural environment and management of communal decision-making passed on through the generations. Replicating the practices of their previous generations is the safest way to manage their lives. The goal of the community is not monetary gain but a harvest surplus to bridge a lean period when harvests failed.

Practices within Indigenous community are amazingly diverse. Agricultural communities in Southeast Asia, for example, never rely on a single crop. When the field is planted with the staple crop (i.e. rice), the compound around the house is planted with secondary crops and garden vegetables. Additionally, there are fish in the pond, a few chickens and ducks, a small ruminant (goat and sheep), and occasionally farmers will raise livestock like water buffaloes and cattle. Off-season, the main field is planted with a secondary crop that requires less water (i.e. soybean, corn). Diversity in planting, practiced for generations, safeguards farmers against total loss. By their own choosing, community members may replicate the way their parents and ancestors have farmed for generations. Outsiders often misunderstand and misjudge the values of the indigenous community practices. Sadly, outside agencies, mainly governments, think they have solutions to solve indigenous community problems.

Struggle for Recognition of Indigenous Rights

Some field practitioners find that imposing exogenous knowledge does not work smoothly. Communities either resist the imposed exogenous knowledge or do it in exchange for incentives and privileges only for the duration of the imposed programs. Consequently, some practitioners, agents of change, and even academic communities around the world have become advocates for the values of indigenous practices.

Some indigenous communities reject the imposed practices and technologies of development packages that crumble the foundation of their community's livelihood. People in these communities feel that outside pressures for change is unacceptable and perceive them as unfit for their local situations. This rejection can take form of protest, disobedience, and conflict.

Farmers of Brazilian Amazonia, for instance, whose livelihood came from the rubber plant, which grows in the rainforest, organized against the big ranches that were taking over the land and clearing the forests for cattle grazing. Darci Alves Pereira assassinated Mendez who was considered the leading land activist in the western Amazon in 1988. Pereira's father, a rancher, had ordered his slaying after Mendez prevented him from cutting down a tract of forest. In 1990, Pereira and his father were sentenced to 19 years in prison. (*Living on Earth*, December 2002)

The international community has finally recognized the existence of Indigenous Knowledge and the need to protect Indigenous practices before exogenous agencies can introduce new techniques into the communities. Starting with the 1992 Environmental and Development summit in Rio de Janeiro, the United Nations recognized the right for the indigenous communities to exercise their freedom to practice their Indigenous Knowledge. The following is an excerpt from Agenda 21, Chapter 26 United Nations Conference on Environment and Development, Rio de Janeiro 1992:

> Indigenous people and their communities represent a significant percentage of the global population. They have developed over many generations a holistic traditional scientific knowledge of their lands, natural resources and environment. Indigenous people and their communities shall enjoy the full measure of human rights and fundamental freedoms without hindrance or discrimination. Their ability to participate fully in sustainable development practices on their lands has tended to be limited as result of factors of an economic, social and historical nature. In view of the inter-relationship between the natural environment and its sustainable development and the cultural, social, economic and physical well-being of indigenous people, national and international efforts to implement environmentally sound and sustainable development should recognize, accommodate, promote and strengthen the role of indigenous people and their communities (Agenda 21, 1992).

A victory for indigenous people and Indigenous knowledge came in 1993, when the World Bank, the largest international funding agency, recognized that Indigenous Knowledge plays a crucial role in the promotion of sustainable development. Ismail Serageldin, the World Bank's Vice President for Environmentally Sustainable Development, wrote in the foreword of a conference proceedings titled *Traditional Knowledge and Sustainable Development* held at the World Bank, in September 1993. Though this conference made no formal recommendations, a consensus, as reflected above, seemed to be emerging. A new type of relationship or contract was needed among indigenous peoples, national governments, and international development agencies. The old style, top-down or paternalistic forms of development policymaking were no longer acceptable to indigenous peoples. Indigenous peoples were demanding for respect, land rights, cultural integrity, and the right to participate as partners in the development decision-making process. (Davis, 1995 p. v)

The United Nations declared 1993 the International Year of the World's Indigenous People. This then followed by the United Nations' declaration of 1995 - 2004 as the *Decade of the World's Indigenous People*. This series of international recognition and support of Indigenous Knowledge and practice contributes to creating more environmentally and socially sustainable forms of development. Many indigenous communities across the world are empowered to represent the values of their traditions and knowledge, cherished for generations. Rigoberta Menchú, a leader of Latin American Indigenous people, who received a Nobel Peace Prize in 1992, states:

> "We defend our roots not only to preserve them, but that they may flourish and bear fruit. In our struggle to gain respect for economic, social, cultural, civil, and political rights, we cannot agree to symbolic recognition or superficial concessions. Our aim is that all those rights should become effective at all levels: local, regional and national. None of the grave and deep-rooted problems of the world can be resolved without the full participation of the indigenous peoples. Similarly, the indigenous peoples require the cooperation of the other sectors of society.
>
> Many people have said that indigenous people are myths of the past, ruins that have died. But the indigenous community is not a vestige of the past, nor is it a myth. It is full of vitality and has a course and a future. It has much wisdom and richness to contribute. They have not killed us and they will not kill us now. We are stepping forth to say, "No, we are here, We live" (Davidson, 1994, p. ix)

Indigenous people are ready to take control of their own knowledge about life, culture, and technologies and determine the direction they will follow. All they had wanted from the exogenous world and the universal knowledge system was recognition and respect.

CHAPTER 2

LITERATURE REVIEW: INDIGENOUS KNOWLEDGE SYSTEM FROM THE PERSPECTIVE OF DEVELOPMENT THEORIES

Introduction

This review of literatures, from the context of development sciences, covers indigenous knowledge systems (IKS), development theories, farming systems practices, green revolution and integrated pest management (IPM). It mainly explores and presents the relationship of indigenous knowledge system to efforts of community development, adult education and nation building. One needs to recognize this inter-relationship in order to understand the role of sustainability in indigenous communities and how sustainability improves their quality of life. In this context, the use of the term "indigenous community" extends beyond the specific boundary of tribal or native community groups. Chapter 1, pp. 17-19, explained thoroughly about terminology suggested by International Institute of Rural Reconstruction (IIRR). This expansion is to cover communities practicing indigenous knowledge system, wherever they are, despite of their current living location.

Most development theories failed to recognize the importance of indigenous knowledge systems, partially because they develop in the oral cultural domain that, in the literary world, is silent. Indigenous record keeping is restricted to local forms. Formal records may be written, carved, painted or memorized (IIRR, 1998.). Some forms of documentation commonly practiced among indigenous communities were accounts of ancient verses written on palm leaves or inscription carved in stones. In isolated indigenous communities, records keepers have a special function in their communities. Local healers, or shamans, and traditional midwives are record keepers in their respective areas of expertise. Records, in form of memory, are passed to the next generation through oral instructions and apprenticeship. If the record keeper died before passing on his knowledge, the knowledge would be lost. Apprenticeship and the resulting knowledge sharing prevent this. Experts from neighboring villages may participate by training apprentices from villages lacking these experts, thus maintaining the knowledge chain over generations.

This chapter discusses the development mainstream theories and looks more closely into their relationship to indigenous knowledge system. These theories need to be revisited, critically reviewed and compared to the concepts and efforts of indigenous knowledge systems (IKS) for improving the quality of life of community members. Since I chose Indonesia for this study more development context is on Indonesia which also highlights this discussion.

Literature Sources for this dissertation

Sources and literature materials are mainly from various IKS publications. My early reading was an anthology book on Indigenous Knowledge System titled *The Cultural Dimension of Development - Indigenous Knowledge System* edited by, Michael D. Warren, L.J. Slikkerveer and D. Brokensha published 1995 by Intermediate Technology Publication, London. Several articles from this book introduced me to the richness of IK and IKS[1] ideas and helped me understand their main concepts and struggles. Readings on Development theories are mainly from "Development Theories for Educators" a graduate level class I took at the Center of International Education at the University of Massachusetts. Robert Chambers' book "Rural Development - Putting the Last First" and Farmer First – Farmer Innovation and agricultural research which he co-edited with Arnold Pacey and Lori Ann Thrupp, mainly inspired the agricultural and rural development concepts. The concept of environmentally friendly agriculture, organic farming or alongside agro-ecology, contrary to the Green Revolution, is mainly motivated by the book by Nicholas Parrott and Terry Marsden titled "*The Real Green Revolution – Organic and Agroecological Farming in the South*", published by Greenpeace Environmental Trust. Concepts of integrated pest management (IPM) are mainly developed through readings of various reports by staff, experts and farmers involved in the Indonesian Integrated Pest Management project. This project was conducted by the FAO from 1988 to 2002. In addition, I did research over the Internet and found many resources on the topic prompting many of my recent ideas.

History of Indigenous Knowledge System

The history of indigenous knowledge (IK) system became world known through encounters with exogenous partners. History started with mankind's invention of recording tools for stories and messages; Indigenous knowledge

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[1] Indigenous Knowledge System (IKS) is how the Indigenous Knowledge is kept, applied and shared in a system of a community or society. This system covers a few subsystems such as agriculture, medicinal therapy, and astronomy. In many ways, these systems integrate well in a way that it will be difficult to make a clear distinction among them.

system previously known only in the practicing communities achieved universal acknowledgment via reports through the education system, universities and research stations, and cataloguing in libraries. The term indigenous knowledge signifies knowledge recognized and practiced exclusively in a closed-circle community.

Although IK mainly passed on orally, methods and techniques for recording were also verbal, meaning that knowledge has to be memorized by the person. Early IK recordings used drawings and graphics and some used ancient and later modern alphabets as the communities adopted alphabet systems through modern education system. This fits quadrant C in Mundy and Compton's communication model described in chapter one. In that quadrant, IK knowledge is shared – orally or written – with outsiders representing exogenous or universal knowledge recording, cataloguing and integrating it in the library system.

Indigenous Knowledge's Vast Resources on the Internet

Surprisingly IK internet searches resulted with hundreds of thousands hits. It is peculiar for a topic barely existing about fifteen years ago to become so popular today. Using the popular Google search engine (www.google.com) with "indigenous knowledge" in the Boolean search box returned 646,000 hits after about 19 seconds, using a broadband connection. This indicated at least this many web pages containing "indigenous knowledge" were exist at the time this search was executed. A single website may also have several sub-pages containing the same words. Assuming every single page links to an average of 10 other sub-pages, there are at least 64,600 websites worldwide referring to IK and this increase significantly on a daily basis. In October 1995, when the initial interest in the IK systems had just started, the internet search of IK then resulted in a much lower number of hits. At about the same time period, the UMASS library electronic catalog search returned 21 hits and a search of the other Four Colleges in the area returned 18 hits using "indigenous knowledge" as keyword search, therefore the Five College library system of the Pioneer Valley gave a total hits of 39.

An initial personal finding of background and history information of IK relationship to agricultural development found in Nuffic IK pages (http://www.nuffic.nl/ik-pages/ik-network.html). Some early recognition of IK role in agricultural development could be as recent as 1993. John Madeley, a well-known science journalist, wrote in an editorial in the journal 'International Agricultural Development' that '...indigenous knowledge is the largest single knowledge resource not yet mobilised in the development enterprise...'. Seven years later, the situation had changed. There was a growing interest in the role of indigenous knowledge systems play in development, and research generated data showing the relevance of indigenous knowledge as a resource that provides a basis for sustainable and environmentally sound approaches to agriculture and natural resource management (NUFFIC, January 5, 2002).

A strategy was needed to promote indigenous knowledge further and making information about it more accessible to development enterprises. Its focus should be on two major objectives:

(i) ensuring that indigenous knowledge is placed more widely and firmly on the international development agenda, and
(ii) facilitating active networking at the national, regional and international levels

Effective instruments to promote information access to indigenous knowledge and the communication required to reach that objective are needed. These instruments include

(i) Creating a global network of Indigenous Knowledge Resource Centers (IK centers)
(ii) Publishing newsletters, and creating an electronic communication network (NUFFIC, January 5, 2002).

Role of IK in the Building of a Nation

Following, I will present development theories illustrating the undeniable significance of IK as a determining factor in development. IK is a crucial parameter in measuring development sustainability by determining the degree of success and continuation of specific programs upon the departure of outside assistance. Many outside development programs aimed at helping local communities fail because of misunderstanding and miscommunication of their purpose, and the program facilitators unwillingness to listen to the communities they are serving. This translates into repeating the same mistakes. National governments must recognize and respect their nation's IK and IKS and safeguard these pillars of livelihood of their communities.

Referring to the South African IK website www.nrf.ac.za/focusareas/iks/, which illustrated four sub-focus areas that IK may strongly influence the rest of the country's population and the world: (1) Traditional medicine and health, (2) Indigenous food systems, (3) Socio-cultural systems and, (4) Arts, crafts and materials. This website further elaborated on IK crucial research in these areas as follows:

1. Traditional Medicine and Health

Rich biodiversity, South Africa has remained largely unexplored. IK related use of herbs and plants, and animal products, for treatment of diseases were common among the indigenous people. This thrust will support research activities seeking to bring this knowledge to the front. This research will investigate its potential use, its integration into modern society and its potential socio-economic benefit for the communities where such knowledge resides. The focus will be finding benefits of indigenous medicine relating to pharmacology, human health, veterinary medicine, animal health, maternal and child health, and sexual health and disease.

2. Indigenous Food Systems

The focus in research related to indigenous food system will be on indigenous methods and systems of dealing with the food supply. This covers preservation, processing and production, as well as value addition, i.e. vitamins and minerals, with modern technology. Research will also consider and explore the role of microorganisms in these processes and the food systems.

3. Socio-cultural Systems

In this area, research will deal with contrasts, impacts and dynamics of modern versus traditional divide. The focus of the research should be on the delineation of indigenous socio-cultural systems. It should cover ethical and legal systems; education and learning systems; socio-economic systems; conflict management and prevention systems; religion and culture; indigenous languages; indigenous notions of science and technology; and the impact of modern technologies. Attention should also focus on how indigenous communities are resolving and/or balancing these issues, how well is the interface between these and other systems of knowledge.

4. Arts, Crafts, and Materials

The goal of research in this area will be to create space for the holistic and systematic examination of the socio-cultural context of indigenous arts and crafts and related issues such as gender roles, usage patterns, rights, and perceptions. This will also covers materials acquisition, development, innovation, transfer, composition, usage, design and sustainable utilization (National Research Foundation, June 2003).

IK interface with other knowledge systems

Within the larger body of knowledge, IKS crosscutting issues are important to notice as it relates to the holistic development, promotion, protection, preservation, and commercialization of the indigenous communities. The following topics are crucial for consideration:

- Intellectual property rights and IKS: Among themselves, members of a community do not assert ownership of IKS. In contact with the larger body of knowledge and the universal legal system, the local community as the rightful owner, in cooperation with the international community, needs to protect its knowledge ownership to guard against claims of knowledge and registering with the international patent office and profiting from this knowledge or its derivatives by others.
- IKS influence on national policy formulation and governance: Unfortunately, many governments do not recognize the vast existence of IK. Governments tend to become hostile to IK and IKS in their territory. In many countries, the national planning targeted IKS for change. This careless action could easily wipe out their long preserved and valuable knowledge that might uniquely exist among their indigenous knowledge system.
- Integration of IK/IKS into the broader knowledge base: It is a challenge to expose or introduce IK and IKS to a broader community than the one that owns it. Universities and research institutions plays active roles in these efforts as indigenous communities do not actively promote the integration of their knowledge to broader audience.
- National governments and IKS: national government could play crucial role of IKS preservation and development. National government could

look into the legal frameworks in order to protect, promote and enhance IKS. Further, it should investigate the nation's local, regional and international legal agreements and began advocating for their indigenous communities.

- Creation and development of new IK/IKS audits and databases. Efforts for consolidation of existing system outlined in research drives on traditional medicine and health; indigenous food systems; and arts, crafts and materials into a single national database. Cataloging the IK and IKS of indigenous communities is crucial in view of the aging local IK actors and recorders as much IK and IKS died with their keepers leaving a vague recollection of certain IK and IKS.
- IKS roles and challenges in bringing in the recognition of its own renaissance and revival.
- Sustainable resource utilization of IKS has been the key factor for most indigenous communities' maintenance and survival.
- IKS and its interface with other knowledge systems: how continuity sustains communities' livelihood, its challenges with the broader communities, and procuring respect of IKS owners by universal knowledge system (National Research Foundation, June 2003).

Development as Growth

Since the beginning, the term development has always been understood as economic growth. Although the words development and growth have different meanings, people use them interchangeably. Discussions about development usually carry the connotation of economic growth. Factually, development extends beyond the simple economic issues of human life; including a wider range of improvement efforts in cultural, social, political, and spiritual areas and in employment, health and education. However, when people ask the questions "How can we get there?" and "How can we achieve the desired level?" then the questions are changed into:" What cost will it take to get us there?" Often development activities are simplified into exercises of calculating costs against benefits, or input against output, instead of the comparison of before and after the development.

As governments develop plans for nation building, IK was left behind unrecognized and ignored. Most national development planning never considers and integrated indigenous community and their Indigenous Knowledge. As a result, no country's development plan reflects or is sensitive to their indigenous communities. Countries' national plans are more concerns of putting national and international interest, mainly the interest of the donor countries that provided funds. It become obvious with the money poured in to these countries from the donors, these recipient countries will do anything to entertain conditions how they can use these funds. As discussed in various popular development theories none of the nation-building plan created for the sole purpose of benefiting of the communities mentioned in as the beneficiaries of these projects.

Development experts often change the course of development to some not merely economic ventures, especially in developing countries. A number of critics questioned the excessive emphasis on economic growth in the orientation of development (Arndt, 1974) while putting aside such vital issues as community efforts, employment, basic needs and equity of life. Improvements of quality of life are measurable in many different facets of life and dimensions and are not necessarily limited to economic standards.

Like others, Andre Gunder Frank condemned the poverty and underdevelopment of countries in Latin America in direct relationship to the flourishing development and growth of prosperous countries through the impoverishing of the already poor countries. Frank's analysis is based on historical reflection of the colonial-era relationships between the rich and poor, the colonists and the occupied, and concluded the current relationship of metropole and periphery to be the continued impoverishment of the already deprived countries. Indigenous knowledge system in Frank's concepts fit into underdevelopment, the exploited periphery of the metropole concentration of power (Arief, 1980).

Frank uses the term metropole to describe the center pool of power that collects and drains resources from its periphery. Periphery is the surrounding area or territory that supplies resources to the metropole. The drain of resources from the periphery makes it continually poorer while on the opposite side, the metropole becomes continually richer. Gunder Frank used the colonization era as a perfect example of exploiting of peripheries by their metropoles. He highlighted that modern development efforts by developed countries, former colonizers, fell into a similar pattern of the metropole – periphery relationship. Development efforts amplify the impoverishment of the countries being helped.

Donor countries further deplete recipient countries, rendering them more dependent on outside help thus hindering their ability to achieve independence. Development for these countries has resulted in continual under-development (Arief, 1980).

According to Andre Gunder Frank the metropole – periphery relationships also exists within developing countries. Big cities, center of economy, and the capitals are the metropoles; while rural areas, villages, and undeveloped region are the peripheries supplying the resources to these metropoles. Thus a similar impoverishment process takes place. Rural areas become poorer while cities become richer and more prosperous at the cost of rural areas which are experiencing an underdevelopment process (Arief, 1980).

In his book *"Small is Beautiful"*, E. F. Schumacher advised the Third World countries to avoid applying high technology employed by the prosperous countries. Terming it 'energy-inefficient", he showed these technologies were harmful to the environment and people. Schumacher emphasized the beauty of environmental friendly and affordable technology, and so they were more suitable. He advised developing[2] countries to question procedures employed by developed and technologically advanced countries, criticized their technology development as destructive, and recommended to forge their own path by applying technology with human face, technologies which are simple and friendly to the common people. Schumacher, who lived in India and Sri Lanka, found the

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[2] Developing countries is a term used by the International Monetary Fund (IMF) for the bottom group in its hierarchy of advanced economies, countries in transition, and growing countries; recently published IMF statistics include 126 countries. Source: CIA World fact book.

Hindu and Buddhist world perception of using only what is needed and preserving the rest, crucial for the preservation of our limited and non-renewable resources. Schumacher stated that greed evolved into the driving force of modern society, continually feeding on the consumption of the limited resources of the earth. Modern society, with its growth-oriented development, the consumption of limited non-renewable resources such as oil and other minerals, races towards self-destruction. Relying on renewable and alternative energy resources for development makes them sustainable. He further suggested that there must be some technology in between the bullock cart and the jet airplane that fits a community's transportation needs and is suitable, affordable and sustainable for the people in the communities (Schumacher, 1997).

This suggestion earned Schumacher the title of father of appropriate technology. He is the inspiration and drive behind the search for techniques suitable for a particular community. His arguments, made in the mid seventies, became the prophetic statement to a world dominated by a growth attitude of the sky being the limit. Schumacher's conservation theory, suggesting appropriate technologies fitting and affordable to every developing community, recognizes and respects the Indigenous Knowledge Systems. It was Schumacher who included ecological consideration into development perspective, because being ecologically aware is a prerequisite for being economical. A nation's growth and prosperity should not be achieved at the cost of sacrificing ecology. Depletion of our natural resources and contamination of nature cannot be justified for improved living conditions. In chapter 4, the discussion about Integrated Pest

Management (IPM) as alternative approach to agricultural initiative, shows that IPM is a program that values ecology in order to achieve increased agricultural productivity. In IPM, farmers learn through observing and identifying interactions between pests and their enemies, through nature and each other that, how the ecological balance benefits their agricultural production efforts. Field research taught farmers that arbitrary application of pesticides did not only disturbed this ecological balance but also contaminated their own environment.

The current path of development of the third world countries is perceived as more utopist rather than as cutting tools to bring about changes in the path of development itself. Development is measured using economists' terms such as percentage measure in GNP and GDP. Employment opportunity, income distribution, health and sanitation standards, poverty eradication, equity, and basic education are recognized as being important but not as the measure of success as they should be.

In fact, historically, development is viewed as growth, or more specifically economic growth. This rather unfortunate mind set results in governmental improvement efforts based on the dollar value involved. In most Third World countries, monetary funds for development are limited or missing. Harrod and Domar, recognizing this problem, introduced a growth theory model for third world countries based on lacking of development capital. Prosperous countries need to provide capital to underprivileged countries in the form of loans, financial assistance and private investment. Underprivileged in this concept denotes "capital hungry". Arnold Arndt, a development scholar, pointed to Harrod and

Domar of putting the stress on fixed capital formation as the most important source of economic growth and development. They suggested the idea of creating the main policy implication appeared to be "a need to raise domestic savings rate in the poor countries and an opportunity for capital aid by the rich countries" (Arndt, 1987, pp. 2-3).

Indonesia in the Development Paths

For the past four decades, Indonesia, like many other nations, has pursued development growth as defined above i.e. directed at the economic growth pattern. After 1965, following the collapse of communism, and the rise of military power under the Suharto's regime, Indonesia joined the development track becoming one of the major recipients of foreign assistance. Amdt, in his other book on Indonesian economy stated that the history of independent Indonesia includes two contrasting experiences of foreign aid. The first period of 1950-1965, Indonesia received little aid, until ideologically rivalry motivated between western and eastern block countries poured in a large flow of credits for military and civil projects. The increasingly chaotic state of Indonesian economy in the last years of the Sukarno regime, the country left with few real assets of value but substantial foreign debts. The second period began in 1966, when the IGGI consortium of western creditor countries (and Japan) first organized a moratorium or rescheduling of the outstanding foreign debts, and then assisted by the IMF, World Bank and ADB, provided aid in increasing volume (Arndt, 1984, p. 85).

In 1986, Indonesia, hard-pressed by the Netherlands, the leader of the IGGI consortium, to improve its respect for human rights as the condition for continued receipt of the IGGI loan, turned to the World Bank. The World Bank subsequently formed another group of donor countries consortium named CGI, Consortium of Government for Indonesia. The switch from IGGI to CGI funding, initially did not have significant impacts on the country's development policy. However, when structural adjustment policy later put in place in1997, and subsequently enforced rigidly, then the country began to suffer. This funding switch allowed Suharto's regime to continued ruling despite his human right violations. Suharto was able to maintain power and saved his cronies. This regime pursued major Indonesian development achievements, with the concept of prosperity in a technologically oriented Indonesia.

W.W. Rostow "Take Off" Theory and IKS

Karl Marx's "Communist Manifesto" shows predetermined steps of human history, a progression from simple communal family or clan living to the utopian communist society. Another growth theory, clearly opposing Marx's theory, W.W. Rostow describes in his book "The Stages of Economic Growth, a Non Communist Manifesto", a country's development efforts as following five main stages of growth:

1. According to Rostow, initially there is a *Traditional Society.* Traditional society is a type of a society whose structure develops within limited production functions. Rostow categorized this society attitude toward the

physical world as based on pre-Newtonian[3] science and technology, and on pre-Newtonian. This traditional society is not necessarily static but has a set ceiling of attainable output per head. Modern science and technology is either not available or regularly/systematically applied. A traditional society usually devotes an excessive proportion of its resources to agriculture, and all other societal systems are based on agriculture.

2. Then, with the adoption of improved agricultural technologies it moves to the **Precondition for Take-Off** stage, notably marked by its transition process. There the traditional society changes, moving towards exploitation of modern technology. A trend towards economic development is not only perceived as possible but as necessary. According to Rostow, the changes altered the social structure and political system and production techniques substantially. The nature of the transition and its many dimensions are recognized, for example a predominantly agricultural society must shift towards industry, communication, trade and services (Rostow, 1990, p. 18-19).

3. Ultimately, this leads to the **Take-Off** stage, where resistance to steady growth is finally overcome, which is accompanied by rapid growth, trade expansion, and rise of commerce and identified by Rostow by three related conditions:

    1) A return on a 5% or less productive investment to more than 10% of national income

    2) The development of at least one substantial manufacturing sector with a high growth rate

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[3] Rostow's differentiation between Pre and Post Newtonian society is that the awareness of men's new capability for regularly manipulating his environment to his economic advantage (Rostow, 1990, p. 5).

3) The existence or surfacing of a political, social or institutional framework utilizing expansion in the modern sector and the potential external economical effects of take-off, lending growth an ongoing character (Rostow, 1990, p. 39).

4. Following take-off is the **Drive to Maturity** stage, maturity estimated by Rostow to be achieved in about 60 years after the take-off began.

   > "The Drive to Maturity stage is marked with a long interval of sustained if fluctuating progress as the now regularly growing economy drives to modern technology over the whole front of its economic activity. Some of 10-20% of the national income is steadily invested permitting output regularly to outstrip the increase in population (Rostow, 1990, p.9).

   In this stage old technology levels off and the narrow complex of industry expands to a wider horizon and more complex industry. Applied technology, has a shift in focus from coal, iron and heavy engineering to machine tools, chemicals and electrical equipment.

5. The final stage is **The Age of High Mass Consumption** with a shift towards durable consumer goods and services. The actual income per head increases dramatically for a large number of people. With progress the structure of the working force changes increases not only proportionally of urban vs. total population but the population working in offices or in skilled factory jobs also want to pick the fruits of a mature economy. (Rostow, 1990, pp. 4-11).

For Indonesian decision makers, Rostow concept of *take off* is the turning point of a country's growth process and becomes the goal of development itself.

It is perceived that during the take off period economic activities are highly accelerated until level-off maturity is reached.

Rostow identified England as the first country that took-off circa 1783-1802 followed France (1830-1860), Belgium (1833-1860) United States (1843-1860), Germany (1850-1873), Sweden (1868-1890), Japan (1878-1900), Russia (1890-1914), Canada (1896-1914). When Rostow published his book in 1960, Indonesia along with Afghanistan, Pakistan and Sri Lanka, was still in the precondition stage of "Take off".

Rostow concepts of growth acceleration for Nation building do not consider the indigenous knowledge system. He mentioned traditional society as pre Newtonian, and so disregarded their capacity to manipulate their capability to pursue their economic advantages. Traditional society focused their resources mainly to agriculture and less if not at all to other sector of modern technologies. Although Indonesian decision makers recognized informal-sector's major contribution to economic development, their policy was unfriendly, targeting this sector for dramatic change. The informal sector in agriculture consists of farmers owning a very small piece of land, approx. a half hectare, or existing from small-scale land tenure or share cropping; the trade sector is comprised of street vendors, becak or man-pushed tricycle driver in the city, and starving artists. This sector may be a social system with similar characteristics and is mostly closest related to the Indigenous Knowledge System category. Rowtow judgment on the necessity of economic growth would completely miss to understand societies who consider survival as their goal for attaining happiness in life.

Compared to development strategies, the Indigenous Knowledge System targets the internal subsistence rather than external progress. IKS' focus is on subsistence not export, on survival and not pursuit of cash or achievements for progress. For growth development planners, IKS does not even come close to matching any parameters a nation-building planner would use. It is introverted and satisfied with covering only its needs. When a nation is pumping all its resources into accelerating take off, most indigenous communities are indifferent to it. They often fell victim of the nation's development program, and were late to react. Indigenous communities become victim of forest logging projects, dam constructions, and oil drilling and mining operations. In all these projects, the government and private companies inappropriately took their customary land, stripped off their resources for living without proper compensation, polluted their environment, and forcefully dislocated them from their place of origin.

During the period of 1960s through 1990s, Indonesia, under Suharto regime implemented big national transmigration project. This project encouraged landless or jobless people from densely populated area, mainly from Java, to a cleared or logged forest area of Sumatra, Kalimantan, Sulawesi and West Papua. This project will pay the cost of land clearing, transportation of people from Java, construction of simple house in the new area, provision of agricultural home improvement tools, access roads, and supply of food until their first harvest. This project dislocated many indigenous communities in the target area and created "islands" of mainly Javanese population, with more advanced agricultural and trade skills, to control their local economy and businesses.

On the other hand, many internal dynamics of indigenous communities which can contribute to nation building efforts remain unrecognized. Governments failed to build a bridge of understanding between their indigenous communities and the rest of the country. Their lacked of the willingness to listen and open to alternative development perspectives made them bad planners and unjust rulers of the nation. Nation builders use development jargons to show progress like increase in GDP and GNP, per capita income and national growth rates while many indigenous communities are concerned about their family survival and maintenance of their environment and sustaining their resources.

There is a big communication gap about common goals between national planners and indigenous communities. This gap made the target for development plan without chance of their input. Development programs carried out blindly in spite of the negative impact on those meant to benefit, resulted in the mistrust among the indigenous communities.

Many development specialists missed the real dynamic of the indigenous knowledge system. Rostow concept of nation building discussed the concepts of accelerating the nation's growth but missed the details of connecting members of its communities in its massive drive to speed up the whole country to the sole target that is, the "take off". In response to massive citizen protests at the end of the Suharto regime in 1997, following a period of monetary crisis, many development experts stated that the take-off did not happen as expected in timely manner, were able to achieve specific targets but failed in general. While applying the Rostow's acceleration theory to the Indonesian experiences, national planners did not integrate any aspect of the Indigenous knowledge system into their short and the long-term national plan. Indigenous communities were out of the picture in the nation-building plan. They became target for changes that would not necessarily work in their favor, and the worst yet, these communities become victim of big national projects claimed to benefit this population.

Indigenous Knowledge and the On-going Development Trend

Mundy-Compton Window of Knowledge explained in Chapter 1, outsiders tend to perceive Indigenous knowledge as well as the indigenous communities as stagnant. However, there is a direct correlation between Indigenous knowledge system and the statement of development efforts especially regarding sustainability and long term results enjoyed by the projects beneficiaries. Mainstream development theories ignore the existence of indigenous knowledge and its capability in providing and improving quality of life of the community. Development specialists view exogenous knowledge as superior and failed to recognize the existence of indigenous knowledge, which leads to major communication gap between these two knowledge systems. This resulted in the failure of community improvements efforts through implementation of imported knowledge. These projects became the ground for unsustainable practices.

Modern Model of Development

The modern model of development took form after the Second World War. With Europe destroyed and Japan devastated by the H-bomb, the reconstruction of Europe and Japan, later, became the model for nation building. Development activities as an active role of government and outside agencies to improve communities' quality of life in a modern society can be traced back to the post second world war era and the rebuilding of those countries with financial assistance mainly from the United States and the rebuilding of Eastern Europe, with the assistance of the Soviet Union. Development or national reconstruction is the post World War II terminology still used for nation building.

The Marshall Plan was the major development assistance provided by the United States to rebuild Western European nations and Japan focused mainly on physical development targeting reconstruction of buildings, roads, harbors, airports, businesses and industries. It was a great success in post war reconstruction for all Western European countries and Japan.

A similar concept by Harrod and Domar introduced a growth theory model based on the assumption that third world countries are lacking capital (Arndt, 1987) and need rich countries to provide the external capital through loans, aid and private investment for the development of poor countries. Ozay Mehmet mentioned in his book "*Westernizing the Third World, The Eurocentricity of Economic Development Theories*" that economic model, later known as "the capitalization of third world resources," relied heavily on the capital mobilization from western donors to the third world country recipients. Mehmet further stated that it failed because it assumed state intervention on the economy with state enterprises and central planning based on shaky facts and figures, using 'sophisticated tricks invented in the most advanced countries of the world'. (Mehmet, 1995. p. 60)

Development assistance in the late fifties to third world countries by developed nations used a carbon copy of the Marshall Plan. The Big Push theory of industrialization, once considered the financial miracle of Europe after WWII built on massive infusion of American aid. The Marshall Plan developed on the premise of pro capital and pro big: large-scale manufacturing and mega projects were favored over small ones, predicting highest returns and productivity gains through capitalist 'growth poles' of secondary industry. Vastness in industrialization was justified by two sets of criteria: economies of scale and modern technology. The argument in favor of modern technology was of recent origin: it favored capitalist industrialization with higher productivity. (Kaldor, 1967 as cited by Mehmet, 1995, p.65)

The post World War II development approach in Europe was not appropriate or suitable to third world countries. The assistance of mostly capital and physical development brought these countries to a modern era, but unfortunately, the policy makers concentrated this foreign assistance on central government area or the national capital, ignoring the rest of the country. There was very little attention, if any, to human development. While administrators of assistance recognized the needs for human development they focused on service delivery but failed to include communities rooted in a long tradition of living practices. There are a number of significant differences between the third world and the post war European countries. The following table is created to show a comparative perception between Third World Countries in the 60's and Europe after the Second World War:

Table 2. Comparative situation between Third world countries and Western Europe after WWII

Third world countries in the 60's	**Western Europe after WWII**
• Many had recently gained their independence from colonization with very few educated people, lacking of technical expertise	• Newly liberated from fascist German occupation, severely damaged physically but an abundance of educated people and technical expertise.
• These countries were mainly traditional agrarian society.	• Many of these countries have been industrialized from the beginning of the 20th century.
• Heavily in need of capital investment and infrastructure development and human development.	• Needed a very high capital investment to rebuild buildings, infrastructure, businesses and industry.
• Human capital was scarce. Some people educated by their colonial government were mainly administrators and very few technicians.	• Human capitals in these European countries were still plentiful despite the destruction of their buildings during WWII.
• These countries were still struggling to fulfill the basic needs of their people i.e.: basic education, housing, health and sanitation, food and nutrition.	• Issues with basic needs primarily related to accessing the centers of economy. Only out of reach communities might still struggle for basic necessities.
• Communities were poor, but strongly bound to their traditions and abundant in the strong communal indigenous values and practices.	• High influence of capitalistic society which values individual freedom to achieve over communal values.
• Indigenous knowledge system was an integral part of community practices and proven able to sustain these communities during hard times.	• Highly developed in an international knowledge system, supported by universities and research institutions

It was rather unfortunate that development assistance provided to the third world countries used the same model applied to European nations after WWII. The developing countries were unfamiliar in applying this development assistance and the recipient countries had no input on program implementation or effectiveness. In the 1970's many recipient countries had some degree in deciding about the benefits, but their governments did not have clarity on how to approach or represent their communities. Many of these countries were tangled in the modern development jargon to achieve growth. Over-emphasized focus on physical development and minimum social control had created the culture of corruption among government officials.

Many third world country governments failed to recognize the needs of their communities, which were intricately intertwined in the indigenous values and knowledge system. In the “top-down” approach of development pre-designed programs are planned centrally and implemented. Resistance to participation resulted in accusations of being subversive, non-cooperative, a communist or enemy of the people. Green Revolution programs, for the sole purpose of maximizing food production through propagation of high yield varieties grains were run and administered centrally and with iron fist. Other programs, like Family planning to control the country’s population to improve families’ way of life, were also run authoritatively. This approach traumatized the people and undermined the communities’ trust in their government. Indigenous agricultural values and practices were perceived as obsolete and unproductive. Government considered these traditional practices inferior and often perceived them dangerous to the country's development policies. Most of these countries declared democracy and rejected their colonial powers, however, their leaders practiced feudalistic values that had clouded their perceptions and ways in handling of development assistance funds. Corruption, collusion and nepotism by many recipient governments were rampant.

Reflecting on the various decades of development experiences starting in the 1950's through the beginning of the new millennium, we can differentiate eras as follows:

- In the 50's - 60's, many third world countries in Asia, Africa and South America had recently gaining their independence from western colonialism. The development focus was directed on the recovery from the independence wars, intended for repairs of the infrastructures left by the colonialist power. Most of these countries were full of revolutionary ideas but lacked the knowledge of handling administration and economic matters. Human resources were scarce and people's education levels were low.
- In the 60's - 70's, development focused primarily on the layout of modern physical and infra structural constructions: dams, roads, railways, harbors, airports, buildings etc. Significant efforts to move these countries from agricultural based economies toward industrialization were in progress. Recognizing the lack of human resources and education of their people, countries launched massive education campaigns and sent their students abroad for higher education.

- In the 70's - 80's, development targeted human development and peoples' basic needs although the main capital investment was still directed towards physical development. Donors and recipients of financial assistance recognized that the foundations of development are the people themselves. They realized that people in many of developing countries are left behind the super-infrastructures, living in inhumane environments, suffering from malnutrition, lacking of sanitation and clean water, and could not subsist in the minimum level of living standard. Unless the international community realized that these basic needs were addressed appropriately the whole development process will become meaningless.
- In the 90's a few of these countries achieved significant improvements, some of these newly industrialized countries or NICs, like South Korea, Taiwan, Singapore and Hong Kong, advanced to the point of graduating from development assistance. Others, like Malaysia, Thailand, Indonesia and China, economically improved to a rate of Growth Domestic Products above 6%, needing decreased assistance. From the late 90's through the early 2000's some developing countries, like Malaysia, Philippines and Indonesia and some new industrial countries, like South Korea, suffered monetary crisis.

The progress and achievements in development for third world countries, some countries graduated from development assistance and one, South Korea, moved from being recipient to become a donor country. However, at the community level, the main issues and a challenge for countries remain literacy education, agricultural improvement, health and sanitation, food and nutrition, population control and poverty alleviation as well as continual improvement of their living standards.

Most development efforts focused on modernization and industrialization targeted to boost the country's growth rate measurable by Growth Domestic Products (GDP) and per capita income. The Marshall Plan model of development applied to the rebuilding of Europe after the Second World War copied everywhere. Third world nations follow the footsteps of the developed nations almost blindly, at any costs. The worst, this included of disregarding their indigenous communities and their own people traditions cherished and practiced for centuries.

Indigenous knowledge systems, though are sustaining the livelihood of a community, its contributions do not appear on economic charts. IKS has enabled communities to survive for generations. Third world governments believe that modernization and industrialization enable their countries to compete in the international race for achievements. The governments many of these countries replace their traditional and indigenous attributes by imposing modern, industrialized concepts. In doing so, they apply "top-down" planning and implementation disregarding, the day-to-day reality these people face.

IKS and Indonesian Nation Building

Indonesia has been a stanch follower of Rostow's *Five Stages of Growth.* In 1965, Suharto established the five stages of the Five Year Plan known as REPELITA. This appeared to be comparable with Indonesian's interpretation of

Rostow's Stages of Economic Growth. The main focus was the third stage, *Take Off*. PELITA stand for Pembangunan Lima Tahun a Five Year Development Program. PELITA was the implementation of REPELITA, the strategic five-year development Plan. The first PELITA was implemented in 1968. The first five-year development period attempted to improve agricultural productivity through the use of enhanced agricultural technologies. The Suharto government immediately adopted the Green Revolution and gave a local name Bimbingan Masa (BIMAS) which literally means mass guidance. This program was to address agricultural infrastructure needs, brought in the agricultural technologies in order to increase the nation's food productivity. BIMAS was followed by dozens other national programs to develop and accelerate the country's economic growth as well as to improve people's wellbeing. During the first two decades, PELITA gradually changed Indonesia from an agriculturally based economy to an industrial and service economy. After that, which is the fifth period, Indonesia emphasized modern technology and Industrial development. By the end of fifth period, Indonesia's industry had become the leading sector with about twelve percent increase versus an agricultural increase of four percent. The government of Indonesia, like in many industrializing countries, had shifted its focus to industry. Around the mid-eighties, Indonesia was setting up policies to increase its exports through improved processing and packaging methods.

During the five PELITA periods, Indonesian government never considered Indigenous knowledge Systems as part of the Indonesian development plan.

Three years after one of the major outbreaks of the brown plant hopper (BPH) in 1983 that destroyed the rice bowl area of Indonesia, the government launched the environmentally friendly Integrated Pest Management (IPM) program, a people's centered approach to agricultural policy. IPM was introduced as an alternative to the ongoing Green Revolution. Although IPM was not meant to replace the Green Revolution, its basic introduction and training techniques apparently opposed the Green Revolution common practices. IPM uses field school to introduce the intricate inter-relationships between crops and the environments through agro-ecology analyses with farmers. This agro-ecological approach identifies crop-damaging insects and beneficial insects preying on pests and thus protecting the crops. Chapter 6 elaborates on the field school methodology and the agro-ecological system analyses introduced by IPM that revolutionized farmers' attitudes toward farming and revitalized Indigenous knowledge Systems. IPM uses a critical analyses approach to teach farmers how to understand the complex agro-ecological relationship existing in their fields.

Indonesia's Country profile

One needs to understand Indonesia's country profile in order to understand the complexity of its human and natural resources. These profiles will clarify development contexts explained in this writing:

- With a population of 231 million, Indonesia has the fourth highest population of the world after China, India and the United States.

- Located on the equator line, Indonesia is an archipelago country, consisting of the five largest islands in the world, Sumatra, Java, Kalimantan, Sulawesi, and Irian and more than 13,000 other smaller islands.
- Indonesia is rich in natural resources, including oil and other minerals, forests, fisheries, and marine products.
- Indonesia produces various indigenous agricultural commodities such ascoffee, tea, rubber, palm oil, sugar, and spices.
- In 1984, Indonesia declared food sufficiency and switched from a major food importer to become a food exporter. The short lived food sufficiency was achieved through Green Revolution agricultural technology. In 1985, however, when the brown plant hopper (BPH) outbreak destroyed rice harvests in Java's northern coastal area, known as Indonesia's traditional rice bowl area, the country became a rice importer again.
- Indonesia is moving rapidly toward industrialization, initially aiming to import substitution. Later, the country will process raw products into half processed and finished products and push towards producing export-oriented products.
- In 1995, per capita income was estimated at approximately $ 1030, this level had placed Indonesia among middle-income countries. A monetary crisis in 1997 dropped this per capita income to about $670. As of 2004, Indonesia was still on a slow economic recovery.

- Throughout the past three decades, Indonesia has achieved a high rate of economic growth, exceeding its population growth rate,. This growth averaged about six percent between 1970 and 1995; a progress achieved despite several external difficulties including a dramatic shift in the price of oil and wide ranging international currency realignments, that effected the terms of trade and the value of Indonesia's external debt (Country Profile 1994-95, p 18).
- Since 1998, the International Monetary Fund (IMF) and the World Bank (WB) pushed Indonesia to adopt a proactive Structural Adjustment Policies (SAP) to remedy its economic growth. Gus Dur (2000-2002) and Megawati (2000-2004) government however, were hesitant to follow IMF and WB advice, as it would disturb the social and political structure of the country which would create a backlash on their popularity support. In October 2004, Susilo Bambang Yudhoyono becomes the sixth president of Indonesia. The current Yudhoyono administration subdues to SAP and its economic policies deregulates almost every aspect of Indonesia's private sectors. Structural Adjustment Policies are economic policies which borrowing countries must follow in order to qualify for new World Bank and International Monetary Fund (IMF) loans and at the same time help them make debt repayments on the older debts owed to commercial banks, governments, and the World Bank. Designed for individual countries, SAPs have common guiding principles and features, which include export-led growth, privatization and liberalization, and the

efficiency of the free market. SAPs generally require countries to devalue their currencies against the dollar, lift import and export restrictions, balance their budgets and not overspend, and remove price controls and state subsidies (The Whirled Bank, 2005). Structural Adjustment Policies have been imposed to ensure debt repayment and economic restructuring. Nevertheless, poor countries have to reduce spending on public services like health, education, and development, while debt repayment and other economics policies become the priority. In effect, the IMF and World Bank have demanded that poor nations lower the standard of living of their people (Global Issues, 2005).

Problems Related to Expansion of Indonesia's Growth

Indonesia's growth resulted in many economic benefits; however, the following negative effects influenced these t achievements:

- Indonesia's progress and development achievements did not extend to the indigenous communities. Though promised to benefit from the country's development, Indigenous communities, suffered from loss, anxiety, and fear when encountering government plans. Including the subsistence farmers in the rural areas and non-formal economy groups in the cities, Indonesia indigenous community might comprise about eighty percent of the population.
- Equality issues exist; there is accumulation of wealth for a small group of people while the majority of people are poor. The increasing national income is not distributed equally to the people. In the seventies,

Indonesian leaders justified the old "trickle down" theory, asserting that if a country enriched more of the wealthy, in due time the accelerated growth would filter down and spread throughout society, bringing the benefits of capitalist growth to the poorer segments of developing societies. (Mehmet 1995, p. 85). The government in Indonesia did not address the economic disparity or attempt to erase it through strategic planning. Rather, the government took a short-cut approach by oppressing any movement demanding fair salaries, a higher minimum wage and a safer working environment. Government leaders never addressed the poverty alleviation as a national priority. In 1995, 15.7% Indonesians lived below the poverty line. In 1999, after experiencing a two year monetary crisis, this number increased to 27.1% (The World Bank, 2002). As most of Indonesia indigenous communities are distant from the center of prosperity, they never to receive any effects from this development.

- Growth without equity is unbalanced and limits future growth. Long-term, it is a time bomb that will explode when political and social stability breaks down or when people cannot take these economic injustices any more. In 1997, people and the students protested against the Suharto regime, rioting in the streets and looting grocery shops, department stores, and even small private markets. Indonesia's growth experience caused economic disparity, inequitable shares of wealth, corruptions among government and non-government employees and many injustices in the society.

- Indonesia's large youth population demands jobs. Job provisions in the near future are required to keep this young population employed that way they do not go in the streets to make troubles and create violence. Even though Indonesia's industry requires a lot of manpower from the labor force, the nature of the industry requires a limited number of employees with specific skills. Labor absorption from the booming industrial sector is limited by the nature of the industry itself, requiring trained or semi-trained personnel that can be immediately recruited. Meeting this demand and tailoring education and training to the industries requirements presents a new challenge.
- Indonesia's departure from oil dependency is not a reliable option. Much of the substitute revenues are generated from wood products. Indonesia has been clearing its forest at rate of 1 million hectares per year, (World Bank, 1990, p. 2) which will result in the loss of its tropical forests, the destruction of the tropical forest's intricate life, and the extermination of many species. This presents devastating environmental impacts, as these forests are considered the "Lungs of the World" and homes of many un-found species. Although, forests are considered renewable resources, once logged, the primary virgin forest is lost forever. Although the world would like Indonesia to preserve more of its primary tropical forest, as long as the international community buys their forest

products, Indonesia will continue to cut down its forests. Because raw logs were banned for exports, Indonesia now processes the wood for export. More rigorous measures must be applied in replanting harvested trees and a stricter forest management system to safeguard the continuous harvesting of the forest many years in the future. Indonesia needs a long-term planning forest management system to maintain a long and profitable forest operation. At the same time, it needs to preserve the remaining tropical forest and jungle for the world's conservation. Many of Indonesia's indigenous community lives under the canopy of this forest. With forest devastation many indigenous community livelihood is disabled. These communities are displaced as their living space is taken over by large corporations exploiting their living environments.

- Technology applied in most cases is not environment-friendly; it is polluting the environment, poisoning the people, and degrading nature. Indonesia has become the dumpsite of older technologies, which are no longer in use or even were banned in developed countries. Machinery with poor emission rates are allowed to operate in Indonesia, when the same machines are not allowed in their original countries due to stricter emission standard. Such machines include older shoemaking and garment machines.
- Applied technology is affordable only through foreign assistance. This situation creates an increasing degree of dependency towards developed countries So far, Indonesia has not put any significant efforts on research

and development of its own. If this situation continues, Indonesia will not become a leader in technology. Many of Indonesia's industries and manufacturers are using older machines and technologies of the developed countries to produce cheaper goods. Multinational companies like Nike and Adidas move these machines from their country of origin, then refurbish and reinstall them for operation in Indonesia.

- The Dual system of economy, introduced by Booke, in his book, *Economics and Economics Policy of Dual Societies - As Exemplified by Indonesia* (1953) still exists in Indonesia. There is a Distinction between the 'traditional' system and the 'modern' system, the socialistic and the capitalistic system, local and imported system. In the Indonesian system of economy, both systems have co-existed since Dutch colonial times. This dualistic system of economy produced a dualistic society; its affects are still felt today. This economic system created a modernized and enhanced portion of the population, while leaving the rest left intact, undeveloped. The Dutch developed projects that brought the most revenues to the colonial power such as, plantations, harbors, roads, mining industries, etc., for export, rather than agricultural development that would benefit common Indonesian people.

Agricultural Development Programs of the Century

During the late 1960's, the Green Revolution was Adopted by almost all developing countries posed as recipients and funded by most of major western countries this program run for about four decades. Although the program excited many third world countries' governments, farmers at the grass root level that had to implement the program, resisted it. Farmers resisted this program because it failed to recognize farmer's needs and preferences. The Green Revolution program assumed that raising production of food commodities to the level of abundance would alleviate the world hunger. Indonesian government adopted the Green Revolution in 1968, known nationally as the BIMAS program. Since its beginning, green or environmental organizations challenged the Green Revolution program by launching various initiatives of alternative agriculture campaigns. The critics noted that massive dumping of various inorganic fertilizers and chemicals pesticides into food crops grown by poor farmers around the world was destructive to the environment. They also noted that the ecosystem suffered from toxic residues that would cause harm to the environment and to living creatures and eventually to humans at the top of food chain.

Two decades later, after a number of brown plant hopper (BPH) outbreaks resulted from calendar spraying of pesticides in the rice-bowl area in Java, the government launched Integrated Pest Management (IPM) a program of the Food and Agriculture Organization (FAO), a United Nations agricultural body. IPM encouraged farmers to observe agro-ecological balance when growing their rice crop. The FAO had originally endorsed the Green Revolution, but changed their position in order to protect the farmers and the environment. The IPM program started with small-scale initial training to pest observers and framers between 1986 and 1988. A pest observer is a sub-district level field staff hired by

Directorate of Food Crop and Plant Protection, a division of the Department of Agriculture. He or she is to observe occurrence of pests and report to the district office. It developed into a full National Program in 1989, because it proved to be the most cost-effective program for rice production in Indonesia. Decisive research conducted during 1979 - 1986 found that indiscriminate application of pesticides to eliminate the rice brown plant-hopper, an introduced pest, also destroyed the beneficial local predators of rice-feeding insects.

Green Revolution and Impacts to IK

Green Revolution was one of the largest agricultural development program ever launched in the last century with the purpose of promoting high-yield production of staple food commodities to fight the world hunger using the most advanced agricultural technologies available at that time. This program was adopted by almost all the developing countries around world.

> In 1968, when the administrator for the U.S. Agency for International Development (USAID) wrote in his annual report that there was a big improvement in Pakistan and India, he said, "It looks like a Green Revolution." That is how the label 'The Green Revolution' got started. As an aside, the "greenies" have nothing to do with the Green Revolution, which is all about alleviating world hunger (Interview with Borlaug, November 2002).

Dr. Norman Borlaug, the founder of Green Revolution also a plant pathologist from the University of Minnesota stated that the Green Revolution started in the 1940s, funded by the Rockefeller Foundation, aimed at assisting poor farmers in Mexico to increase their wheat production. The scientists in this program spent nearly 20 years breeding high-yield dwarf wheat that resisted a variety of plant pests and diseases and yielded two to three times more grain than traditional varieties. In the 1960s, the program expanded to teach local farmers in Pakistan and India to cultivate the new wheat properly. The results were wonderful:

- In 1970, Pakistan produced 8.4 million tons a significant increase from 4.6 million tons in 1965.
- In the same year India's production was 20 million tons a substantial increase from 12.3 million ton in 1965.
- In the 1980s, the success of the Green Revolution spilled over to China, which is now the world's biggest food producer (Interview with Borlaug, November 2002).

Borlaug claimed that China became the largest world food producer as the result of the spill over of Green Revolution. This claim seemed rather premature and needed some extensive data to show the direct correlation between China successes as number one food producer with the Green Revolution technologies spill over that happened in 1980. The above claim simply did not prove China's climb to become world largest food producer as direct result of the Green Revolution.

On the contrary, the Green Revolution experience in Indonesia suggested otherwise. Indonesia declared the Green Revolution as a national program since 1968; however, Indonesia only achieved the status of self-sufficiency in rice for a one-year period, in 1984. On the following year, Indonesia again became a major rice importer. This unsustainable, temporary achievement was difficult to accept as proof of the Green Revolution's success. In fact, the Green Revolution created significant negative impacts related to farmers' loss of freedom in managing their farms, the poisoning of the environment, deterioration of the social fabric the village communities, and the financial disadvantage to the farmers. For further details, please see Chapter 8, pp. 281-286.

Peter Rosset, the executive director of the Institute for Food and Development Policy, also teaches at Stanford University, pointed out that counting China as a follower of the Green Revolution was a missing claim. China was occupied with the Cultural Revolution, when the rest of the world was preoccupied by the Green Revolution. Rosset's data shows the opposite. China's success did not come from dramatically increasing the total number of production, but rather by increasing equal distribution of food. China's equitable policy on food production was able to bring remarkable difference in China, where the number of hungry dropped from 406 million to 189 million. Rosset claimed China was more successful in bringing down the number of hungry people through their Cultural Revolution by providing equitable access to land to many Chinese poor, than the rest of the world through massive efforts of quadrupling food production. The Chinese Revolution that implemented broad-based changes in giving access to land that enabled many Chinese poor to raise their standards of living (Rosset, 2000). Therefore, Borlaug's claim that China's ability to produce abundant food was the result of indirect correlation of the Green Revolution has no base.

Dr. Norman Borlaug received a Nobel peace prize in 1970 for his successful efforts to contribute to significant wheat production increase in India and Pakistan. At his Nobel lecture, Borlaug declared that the Mexican wheat yields began to climb in 1948, and have continued their upward trend to the time of his Nobel acceptance speech in December 1970. He claimed that during the past twenty-six years, the Mexican national average has risen from 750 kilos per hectare to only slightly less than 3,000 kilos during the harvest in 1969; this approximated to a fourfold yield increase. During the same period, total production had increased sevenfold. Mexico had become self-sufficient in wheat production for the first time in 1956 and has remained self-sufficient since. This "quiet revolution" in wheat production in Mexico became the progenitor of the green revolution in India and Pakistan a decade later (Borlaug Nobel Lecture, 1970).

Borlaug further mentioned in his acceptance speech that fertilizers produced another marvelous plant response. The use of fertilizer increased yields to four and a half thousand kilos per hectare, lodging—falling over of the plant due to heavy panicles/fruits weight—began to limit further increases in yields (Borlaug Nobel Lecture, 1970). Therefore, with this illustration, Borlaug showed the world that just by changing the cultivar, in such as the case of Mexican dwarf wheat, he was able to increase harvest by a factor of three. With fertilizers, yields increased even more significantly---up to 5 times.

The politics of the Green Revolution began with Indonesian adoption of Green Revolution that occurred in 1968. Suharto was a zealous promoter of Green Revolution in Indonesia. It began in 1965, when Suharto crushed communism and took power from Sukarno. These moves pleased all the western block governments and the world's capitalists, who then showered the country with loans, grants and technical assistants. Suharto enjoyed the western supports and became a military dictator. He remained in power for 36 years.

BIMAS was introduced to farmers as a compulsory program. Through agricultural extension agents, government gave farming instructions and provided farmers with credit packages. With BIMAS intensification program, Indonesia declared a rice harvest of at least 7,000 kg per-hectare, a record high for rice. With the Green Revolution Indonesia claimed self sufficiency in rice was achieved in 1984. This status did not hold for too long. A year later, Indonesia fell back to its old status as one of the major rice importers of Southeast Asia. Indonesian success in rice growing during that time period had always been shadowed with a number of harvest failures and pest outbreaks, mainly caused by brown plant-hopper (BPH), and rice *tungro* virus (RTV) carried and spread by white butterflies.

Integrated Pest Management – an Alternative

Pest outbreaks and harvest failures in Indonesia's rice-bowl area overshadowed the any success of the Green Revolution , though rice production rose to level of a minimum of 7,000 kg per hectare. The initial success of Green Revolution did not sustain for long period. The Indonesian modern agricultural history showed pesticides had triggered Brown Plan Hopper outbreaks; also, the continuous application of inorganic fertilizer damaged the soil. Soil became hard and suffocated the crops. Peter Ooi blamed the Green Revolution for creating the myth of the necessity for pesticides application as "modern" requirement:

> The Green Revolution is largely responsible for the perception that insecticides are modern day imperatives. The occasional yet devastating effects of locusts and other insect pests and their links to famine have provided fuel for this. Hence, insecticides were packaged into the Green Revolution. This led to many pesticide subsidy schemes which resulted in widespread application of insecticides by farmers. The result was a false belief that without insecticides there would be complete crop loss (Ooi, 1998, p. 3.).

In 1989, the Government of Indonesia initiated one of the most aggressive IPM programs ever undertaken, involving 1000 Pest Observers, 2000 Field Extension Workers and 100,000 farmers to be trained over three years. FAO was invited to form a training team and make a separate bilateral agreement between FAO and the Government of Indonesia (GOI). The United States Agency for International Development (USAID) supported the program with a special policy support grant that would allow unusual freedom of implementation to GOI related ministries (Indonesian National IPM Program, 1991).

The main initiative of IPM is to maintain the level of rice production, while breaking away from the heavy application of pesticides that kill both pests and their natural enemies. In November 1986, Suharto, the Indonesian president who finally understood about the danger of careless spraying, banned 57 chemicals deemed most responsible for BPH and other pest outbreaks. This presidential decree also established IPM as a national policy. The government's long standing subsidy of 85% of the cost of pesticide (running well over 100 million dollars annually) was cut to 75%, then 55%, briefly to 40% and finally to zero% in 1989. (Useem, 1992)

Decreasing use of pesticides has switched IPM toward venturing to further step toward alternative agriculture. This term refers to any agricultural ventures away from conventional or fuel-based agricultural practices. Alternative agriculture often means organic or traditional agriculture conforming to nature and agro-ecological principles. In IPM training, farmers are introduced to a combined agronomic and ecological approach that can be used by farmers as tools for their decision-making in managing their own farm or rice field. It is the main program philosophy and goal to maintain the farmers as managers of their farms, who make independent decisions based on what is best for their situation.

Education encouraging critical thinking has been the focus of IPM training activities. In contrast to the Green Revolution approach where farmers received explanation and instruction on what to do about their rice crops, IPM uses Field Schools (FFS) to assist farmers in learning how to make their own decisions about their crops. The rice IPM Field School is a season long learning experience. In the Field School, farmers learn about agro ecosystem management. The Field School makes use of the rice field as a field laboratory. In this laboratory, FFS participants learn about the ecology of the rice field by means of regular observation and hypothesis testing.

Over the program's twelve years, IPM has become the entrance gate to organic farming. The agro-ecological analytical skills taught at IPM Farmers Field School has helped farmers to take the further challenge and make inquiry about their farming practices in addition to practices imposed upon them by programs like BIMAS. Because of IPM training, many IPM farmers have become completely organic, especially after the positive response of health conscious consumers who are willing to pay as much as 50% more for organic rice than for BIMAS rice.

Becoming organic is a trend that being adopted worldwide. Organic and Agricultural Approach (OAA) is an increasingly significant practice of modern times. Greenpeace report by Parrot and Marsden titled *The Real Green Revolution – Organic and Agroecological Farming in the South*, published by Greenpeace Environmental Trust, London, in 2002, identified some of the positive trends currently emerging, here are a few examples:

- Latest estimates of land managed according to ecological principles vary from 15.8 to 30 million hectares (equivalent to about 3% of agricultural land in the South). This figure would almost certainly be much higher if de-facto organic agriculture practiced by traditional subsistence farmers was included.

- Two thirds of new members of the International Federation of Organic Agricultural Movements (IFOAM) come from the South, i.e. developing countries.
- International agencies – principally the UN Food and Agriculture Organization (FAO) and the Centre for Trade and Development (UNCTAD) – have realized the potential of organic farming in raising farmers' incomes, creating jobs, and enhancing food security.
- Cuba has been moving towards a nationwide organic system and 65% of its rice and now nearly 50% of its vegetables are produced organically. Argentina now has the largest area of land under organic cultivation of any country in the world, after Australia. (Parrot, 2002, p. 4.)

Organic Farming and Increasing in Yields

For people who believe that crop production using organic methods will produces less, they are often not correct. Fewer chemicals often produce more and healthier food products. There is a widespread assumption that converting to organic agriculture means a decline in yields has proven false, a conclusion is supported by overwhelming evidence contained in this Greenpeace report. Case studies from a number of different countries with radically different practices, local conditions, and crops show dramatic increases in yields as well as benefits to soil quality, a reduction in pests and diseases, and a general improvement in taste and nutritional content of agricultural produce. For example:

- In Brazil, the use of green manures and cover crops has increased yields of maize by 20% to 250%.
- In Tigray, Ethiopia, yields of crops from composted plots were between three and five times higher than crops treated only with chemicals.
- In Nepal Report claimed yield increases of 175% from farms adopting agro-ecological management practices.
- In Peru, the restoration of traditional Incan terracing has led to increases in the order of 150% for a range of upland crops.

The importance is not just that yields are increased, the increases are under the control of the farmers and communities that produce them, in contrast to a high input agricultural model where the benefits go to the manufacturers of equipment and chemicals and seed merchants (Parrot, 2002 p. 5.).

IKS, Organic and Ecological Agriculture

IKS in the context of agricultural practices is always related to organic and ecological characteristics. Indigenous farmers farm the way they have done for centuries. Their skills and techniques have been passed on for generations and continue to exist with the communities.

Modern organic agriculture came about as reaction to conventional or manufacturing agricultural system that relies heavily on application of inorganic chemicals and machineries. Modern organic agriculture is the revival of traditional or indigenous agriculture with strong ecological analyses and awareness. This agriculture practice adopts and integrates modern research findings that use natural substances and microorganisms for pest control and improving soil fertility. Organic agriculture rejects any application of inorganic chemicals and fertilizers and promotes application of organic matter like compost, nitrogen fixing organism, application of liquid fertilizer, natural pest repellent and natural pesticides. Modern organic agriculture is different from traditional or indigenous agriculture as by definition, the traditional or indigenous agriculture is intrinsically organic, and natural; while the modern organic agriculture came into being as a reaction to the invention of inorganic materials came later during the modern times. Also, much of the modern organic agricultural soil has been converted from the Green Revolution system of agriculture. The conversion to organic agriculture land requires a significant period of time for moratorium. The European community requires a minimum of 10 years in order an agricultural land could reclaim its organic title back.

Ecological agriculture emphasizes the importance of maintaining ecological harmony in food crop environment. This concept refuses any interference that will cost the disruption of ecological balance in that environment. Application of pesticides is considered a major disruption to the micro ecological environment of food crops. Ecological agriculture rejects any significant human interference that will permanently create ecological imbalances.

CHAPTER 3

METHODOLOGY: THE ORIGIN AND USES OF KNOWLEDGE

Introduction

This chapter discusses methods for conducting the study, including ways of constructing arguments to prove the thesis. The challenge is to come up with the right answers to the questions posed by this study. There are one thousand ways to Rome, but it is necessary to choose the best way to get there. It is important to reach the destination in the most economical and convenient way.

A quote from the late professor David Kinsey from the Center for International Education (CIE) whose class on research methodology I attended in 1994. This popular quote among members of CIE community states: “Research or study is about who is going to know what and for what purpose.” This struck me as a very simplistic statement. However, shortly after taking that course, a friend asked that I watch her four year old son for the evening, which I agreed. The boy and I played a computer game with trivia questions for children his age. One question was, “Who is Gepetto?” Neither of us knew the answer. Suddenly, the boy seemed to remember something, left and then returned with a cartoon video “Pinocchio.” After replaying a section of the video he realized that Gepetto is Pinocchio’s father. It was very impressive.

Reevaluating Professor David Kinsey's statement with this incident in mind, one can realize that the four year-old boy had followed Kinsey's approach. This can be demonstrated by breaking the trivia question into smaller fractions.

Question: Who?

Answer: Four year old boy

Question: Is going to know what?

Answer: The answer to the question, "Who is Gepetto?"

Question: For what purpose?

Answer: To answer the question from the computer game.

Kinsey's definition of research is simple but powerful. By this definition a four year old boy can "do research", then—without a priory or disrespect—certainly farmers, members of indigenous communities, can also do research. In his class, *Organizational Management for Small NGOs*, Professor Robert Miltz repeatedly quoted the founder of Dairy Mart's famous KISS principle: Keep It Simple Stupid. Simplicity works! The methodology for this study was designed with this principle in mind. The study is divided into 4 categories of questions, which attempt to satisfy the following issues related to the study:

Background of this study

- Which study am I conducting?
- What are my motivations?
- What are my assumptions?
- What attracted me to this study?

Purpose of this study

- What is the purpose of my study?
- What are the goals of my study?
- What do I want to convey to the academic community or the world?

Conducting this study

- What are my research questions?
- How can my questions be answered?
- What tools will I use to conduct this study?
- Where are my research sites?
- Why did I choose these sites?
- What are the actions I want to study?
- Where can I observe the actions I want to study?
- What data I am looking for?
- Who can I interview to gather my data?

Data processing

- How will I process my data?
- In which format will I present my data?

Background of This Study

Professional qualifications for conducting this research include serving as a community promoter, a trainer of field promoters, and in top managerial positions for community development programs, specifically agricultural development programs. The location of the study can be found within the agricultural and indigenous communities, mainly in Indonesia, where the positions were based. Experiences in these locations led to questioning establishments, ruling powers, and issues related to injustice and oppression in society, thus, furthering the ideals gained from studying philosophy as an undergraduate in a Jesuit seminary. This study is a result of the knowledge gained from recognizing the role and importance of indigenous knowledge (IK) and its systems within the communities.

This became especially clear, while serving as manager to a large agricultural project in East Timor, illustrated in Chapter 1 of this dissertation. The five million dollar technology-driven agriculture project known as Green Revolution attempted to achieve self-reliance in food productivity for the country. However, discouraging farmers to prepare their rice fields in the traditional way by using water buffaloes also destroys IK. When, in the end, the traditional method was by far superior, it was evident that IK must be preserved and respected.

Indigenous knowledge is recognized as the main knowledge utilized within indigenous communities around the world. It enables these communities to survive and sustain themselves through many difficult times. A system of indigenous knowledge, especially among the farming communities, was known to be able to guide and help farmers to prepare and plant their crops optimally considering their limited resources and their specific local problems.

In many ways, the indigenous knowledge and skills of communities in Indonesia and many other countries have been negated. Many development specialists and policy makers consider indigenous knowledge to be inferior and obsolete, therefore, encouraging farmers to reject and forget their indigenous knowledge. These outside experts consider such knowledge as an obstacle to modernization and development. During the period from the 1960s to the early 1990s, modernization and development were buzzwords for most governments of developing nations. These governments told their people that their knowledge had to be replaced with improved and better knowledge. This 'better' knowledge was imposed from outside by outside agencies on indigenous communities around the world.

In the field of agriculture, for example, many governments and private agencies celebrated exogenous knowledge with the assumption that modern agricultural technologies will enable farmers to produce superior products, better yields, grow higher pest resistance, and faster growing rates. Because it was developed within the modern laboratory, they believed it was more scientifically rigorous. Many experts and academics assumed that exogenous knowledge would work anywhere. However, the controlled conditions of the laboratory setting could not be replicated by Indonesian farmers at an affordable cost. For this reason, farmers' field productions never achieved results similar to those of the lab.

Agricultural practices within indigenous communities around the world are diverse in their local farming practices. Asian farmers might have fields of rice, while the space around the house is planted with garden vegetables. Many raise fish in conjunction with their rice crop – not to speak of poultry and small livestock. Better off farmers will often raise livestock like water buffaloes and cattle. These practices have existed for generations. Diversity insures against total loss or complete failure; their lives are full of backups. Besides, from their perspective, they might have no other choice but to farm exactly how their parents had farmed. These communities never rely on outside resources for the simple reason that such resources are either inaccessible to them or just too expensive.

The value of the indigenous knowledge system seemed to be recognized by the practicing community itself. Local communities have learned that using their traditional techniques is the key to their ability to sustain themselves. People have learned over generations how to manage certain agricultural techniques, how to make traditional medicines, how to preserve their culture, and how to produce arts and crafts that would help preserve their natural environments. With a subsistence mind set, people do not think about cash and other commercial value; rather, they simply live with the hope that this year's harvest will suffice until the next harvest. In actuality, their traditional practices are what environmentalist call "sustainability."

Most outsiders are blind to this kind of perception and understanding. They misjudge the merits of the indigenous community practices, because they use a different set of parameters or the techniques to which they are accustomed. These outside agencies—operate mainly through local governments—assume they have the best solutions. This kind of arrogance can not help these communities to improve their livelihood. Many outsiders make no attempts to learn about these indigenous communities, a simple way by simply observing and understanding how these communities struggle in their daily activities.

Many field practitioners have discovered that their imposition of exogenous knowledge on Indonesian communities never worked. People either resisted or rejected this exogenous knowledge or they would accept it only in exchange for the incentives and gimmicks attached to it. People went back to their old practices when incentives were gone, thus ending the imposed programs. Some of these outside experts or “change agents” realized the mistakes they had made and voiced concerns about the problems of indigenous communities. More and more of these outsiders have been taking it further by advocating for more realistic policies and by respecting the values and merits of indigenous practices they had once criticized.

Indigenous knowledge is public domain in the community: knowledge that is generated, nourished, recognized, and spread amongst the community, belonging to everyone. This is the kind of knowledge that the community as a whole and its individual members take pride in. It is their domain and they pass it on to the next generation. Indigenous knowledge is the knowledge rooted in a community, inherited over generations and traditional in nature. In the 1960's, this knowledge was perceived as obsolete, inefficient and a barrier to the “growth enhancement” efforts heavily promoted during that time.

A reasonable premise for this study is that indigenous knowledge should be honored and respected, but not allowed to become "tamper resistant" or heavily protected. It is not a purpose of the study to defend and to protect the indigenous knowledge of the community merely to help farmers perpetuate old reactionary way – forever. Rather the hope is to understand the origins of communal knowledge, identify the processes by which a community integrates new ideas, and explain how changes happen with the consent of the community.

In this way, indigenous knowledge becomes the inner drive for changes within the community itself. In other words, it should start from the knowledge and skills they already have. Any new or acquired knowledge should be processed by and integrated with their existing indigenous knowledge system – and only with their consent.

Purpose of the Study

The primary purpose of this study is to identify indigenous knowledge that is currently valued and practiced by IPM farming communities. Further, this study explores how the use of indigenous knowledge contributes to social and physical sustainability of these communities.

A narrower and more specific purpose of this study is to explain the role of Farmer Field School of IPM (FFS/IPM), a non formal education system. How has FFS/IPM helped farmers learn about the IPM farming, a system relies on a deep understanding of agro-ecological system around the crops and its environment? One answer lies in the system's method. This organization used group dynamic techniques including group discussions, simulations and games, role playing, and cultural performances. FFS/IPM was a unique educational system in which real life issue discussions could trigger the follow-up actions needed to fix the identified problems. FFS/IPM resembles a "school without walls" where a group of farmers meet from the beginning the cropping season right through the harvest.

FFS/IPM applied Paolo Freire's consciousness-raising concepts and techniques in the field school learning activities. Paolo Freire was a Brazilian educator, who wrote *Pedagogy of the Oppressed* a work that deeply influenced the 1960's liberation movements. Freire's ideas on education are widely known among progressive educators throughout the world and are very similar to the Freedom Schools in the United States. According to Freire, traditional education seeks to domesticate the oppressed and limit their consciousness. Education for freedom, on the other hand, empowers the oppressed by making them conscious of their oppression and engaging them in struggles to transform the world and themselves. "Conscientization" or "consciousness-raising" must be a never-ending process through which the dispossessed and disenfranchised continue to become both more active and more reflective, constantly expanding their human dignity and identity. Unlike animals, our vocation as human beings is to become more than we are at any given time or place (Boggs, 2000).

Observations of IPM practices and their training approaches at Farmer's Field Schools (FFS) inspired this study. These schools led to revitalization of the indigenous knowledge farmers were forced to abandon during the BIMAS or Green Revolution period. Impressively, the IPM method trains farmers not by giving instructions or dictating “the” solution to farmers’ problems, but by helping them to learn from their own observations and experiences. This approach is an eye-opening process for the farmers and transforms them into critical observers of their own farming practices.

This initial contact with IPM program inspired the following hypothesis: If farmers or farming communities’ sustainability relies on farmers’ owned indigenous knowledge and IPM values and if this reliance leads to the reinvention of traditional knowledge, then IPM could become the basis for the sustainability of agricultural communities in Indonesia.

Research Questions

This study aims to find answers to the following questions:

1. Does the IPM approach facilitate and encourage farmers to reinvent their lost indigenous knowledge that had suppressed since the introduction of government run BIMAS program in the late 1960’s?
2. Can the recovery of IK in the IPM program contribute significantly to the sustainability of these communities?

If the answers to these questions are conclusive, they will serve to reach the goal of this study.

From these main questions, five primary working questions have guided this study. From these working questions, questions for questionnaires were developed to investigate appropriate data in order to search for answers and satisfy the purpose of this study. Among the working questions are the following:

- What indigenous knowledge do local farming communities’ value?

- What indigenous farming practices are being utilized in the local communities?
- To what extent do IPM approaches encourage farmers to complement their indigenous knowledge with new initiatives and innovations?
- To what extent do farmers perceive that the IPM approach contributes to increased productivity?
- To what extent does indigenous knowledge contribute to physical and social sustainability of these local communities?

Significance of the Study

This work will contribute to the enrichment of universal knowledge about the relationship of environment to agricultural techniques, also about ways of sustaining non-industrial agricultural communities, and about techniques for exploring traditional knowledge. This study will contribute to the exogenous knowledge system development of the indigenous knowledge itself. This study could also empower the people participating in the study and serve as an advocate and voice for their dignity and intelligence. Finally, it may also trigger a new understanding among exogenous communities, presenting new perspectives they have never seen before.

The academic context of this study will naturally overlap with the more philosophical aims and justifications listed. The academic enterprise demands more concrete goals. Six significant contributions are described below.

First, this study will expand education theories to include concepts exemplified through programs like IPM. The results and findings will also aid IPM by providing feedback and lesson learned that will be useful for the organization.

Secondly, this study will contribute to the life of the people living in their indigenous communities. This study supports the process of community education through the recognition of indigenous knowledge and self-help efforts to improve livelihood in farming communities. This study and its findings will present the struggle of many indigenous communities. It will help make their voices heard among outsiders.

Thirdly, this study will also contribute to the collection, recording, and cataloging of indigenous knowledge systems, especially those related to community-controlled decision-making. This preservation program is becoming very important as many indigenous communities are fading away from their indigenous practices and IK. This study will record at least some of these IK systems before they disappear.

Fourthly, this study will have a beneficial social-political effect by contributing to the reform of agricultural policy to Indonesia as well as other nations. Hopefully readers of this study will gain from the lesson-learned experiences of other nations, especially in regards to the approach and implementation of IPM.

Fifth, this will contribute to the history of third world development as the IPM grows and helps to counteract previous agricultural development theories such as those promoted by Green Revolution.

Finally, this study will contribute to the pool of the community's own knowledge. People as learners, observers and researchers focusing on their livelihood will receive support and confirmation of their way in practicing their IK. People in these communities recognize the wealth of their own knowledge.

Limitation of the Study

The limitation of the study is specific to local problems and may carry certain characteristics of the communities being studied; therefore, it should not be generalized. Indigenous knowledge as the focus of the study carries very strong components of locality and relates to specific problems faced or encountered by the local indigenous community. It is very important to constantly be aware of the strong focus on local communities. The findings of this study might be unique to the space and time of the study. It would have some possible similarity to other situations, but it cannot arbitrarily be applied to any situation without sufficient study to find common factors that might be applicable in different localities and cultures. In short, this study is not arbitrarily applicable to any situations other than those discussed here.

Another, all too familiar, limitation is bias. Researchers are outsiders meeting with people in indigenous communities. Robert Chambers mentioned six unobserved biases:

1. **Spatial Biases: Urban, tarmac and roadside**. This bias dictates the tendency to visit rural areas only if they are accessible by motor vehicles or tarmac road. This "rural development tourism" tends to choose location near big cities. Visits to villages are often limited to the village centers.

People whom we meet also live near the village road. This bias excludes people in these communities who are most in need, but are invisible because they live beyond accessible roads.

2. **Project Bias.** A project that is current in the village becomes the center of attention for outsiders. Visits from rural development agent, researchers, government officials, and NGO staff focus on the project people and area of the village. They receive repeated visits and become the center of attention from people from outside. There rest of the village gets no attention at all.
3. **Person Bias.** Persons contacted by rural development tourists, local officials, and researchers are often limited to those having certain characteristics, most notably persons who are elite members of that community or male. Female farmers are normally neglected – or they are the users or adopters of introduced systems, skills or technologies who are active, healthy and living. People who are sick, weak, old, and apathetic will become invisible and are not accessible.
4. **Dry Season Biases.** Visits to villages and remote communities often limited to during the dry season. Monsoon season make many of these community inaccessible. Wet season is the season when they most need outside help. Their crops are just newly planted and they are at the end of last year's savings. Famine and starvation are common during this wet season.

5. **Diplomatic Biases: politeness and timidity.** Visitors to the village are often timid in approaching, meeting, and listening to poorer people. Poverty is considered like a disease that makes many visitors uneasy. Both village officials and project implementers tend to hide failures of the programs targeted to the poorer population of the village. There is a mixture of timidity and diplomacy when they have to deal with poverty.
6. **Professional Biases.** Professionals who come to the village to help poorer people of the village are often blinded by their profession. They tend to filter anything they want to know and hear according to their specific interests and miss the holistic view of the problems. This way they misunderstand the underlying web of village structure and problems (Chambers, 1983 pp. 13-23).
7. **Personal Political Bias**. Inevitably, of course, there is the personal political bias of the researcher.

Although this study is going to be conducted with every possible degree of objectivity, the study tends to voice and articulate the importance of indigenous knowledge and practices. In this sense, this study is not “neutral” and contains cases that support the hypothesis.

Conducting the Study

This study uses a comparative approach, looking at community-controlled programs that were initiated by outside agencies using approaches to empower and sustain the community’s control over public domain knowledge. The program chosen for the study is the Integrated Pest Management (IPM) program implemented by the Food and Agriculture Organization (FAO). The sites of this study are the IPM project sites in Yogyakarta and Central Java. The study approach mainly look at how people in the agricultural communities, who participate in the program, would respond to different or alternative development approaches.

This study also observes the dynamics in the communities in response to liberating approaches that enable farmers to experiment and revive most of their indigenous knowledge and practices that were buried or abandoned during the two decades of the Green Revolution. The study observed the degree of freedom enjoyed by farmers due to the liberating approaches consciously made by FAO/IPM program. The main reason for choosing this program is because the program recognizes the power of indigenous knowledge. IPM influences community life with the belief that reliable and sustainable community programs flourish from within the community itself. The following is a brief description of the program.

The FAO-IPM National Program

The National Program for Integrated Pest Management (IPM) of the Food and Agriculture Organization (FAO) is a program to control plant pests using their natural enemies or predators. IPM/FAO was introduced in 1986 using new methods for extending the method to local communities. In Indonesia, the IPM program developed a *"Sekolah Lapangan"* or "Field School" where farmers act as researchers in their own rice fields using agro-ecosystem analysis, which simply means that farmers watch their rice fields and identify the presence and life cycles of pests and their enemies.

The IPM approach combines a laboratory process right in the field with references to traditional practices and indigenous knowledge and facilitates a farmer controlled decision-making process based on their analysis of the problem they find in the fields.

Integrated Pest Management is a method of farming without or with a minimum use of pesticides. In Indonesia, during the Green Revolution era, pesticides were generally applied to the main crop, rice. The IPM started with small-scale training between 1986 and 1988 and developed into a full national program in 1989, because it proved to be the most cost-effective for rice production in Indonesia. During 1979-1986 scientists conducted decisive research which concluded that indiscriminate application of pesticides targeted at the elimination of the rice brown plant-hopper, an introduced pest, also destroyed the beneficial local predators of rice-feeding insects. This in time fostered the unrestrained growth of noxious pests (Indonesian National IPM, 1991).

In 1986, Indonesian Presidential Decree number 3/1986 supported and initiated the IPM concepts and practices, stating:

1. Pesticides are only to be used when other methods of pest control have proven ineffective; specifically when the pest population exceeds established economic thresholds.

2. Type of pesticides utilized and their application methods must take into account the maintenance of natural enemy populations.

3. Pesticides, which might cause pest resurgence, resistance, or other damaging side effects, are therefore illegal and forbidden (Indonesian National IPM, 1991).

This decree was soon implemented and fifty-six pesticides prevalent on the market at that time were banned, primarily the organo-phosphate (OP) based pesticides, which were found to have wide spectrum effects, literally killing everything when they were sprayed. The Indonesian government cut the pesticide subsidy to the farmers, which was about 85% of real market price (Useem, 1992). This was a drastic policy change, as pesticides were normally inserted into the agricultural loan package, a must to the farmers' credit scheme. This policy action is estimated to save the country an average of 120 million US dollars every year.

When the major IPM campaign was launched in 1989, the government of Indonesia initiated one of the most aggressive IPM programs ever undertaken involving 1000 Pest Observers, 2000 Field Extension workers, and 100,000 farmers to be trained over three years. Involving several government ministries, FAO was invited to form a training team and make a separate bilateral agreement between FAO and the Government of Indonesia (GOI). The United States Agency for International Development (USAID) supported the program with a special policy support grant that would allow unusual freedom of implementation to GOI related ministries (Indonesian National IPM, 1991).

All of this preliminary research and legislation created a protective shield for actions at the farmer level in the field. The main challenge of the program was basically to change farmers' information and practices, which had been inundated with the Green Revolution ideas for over two decades.

The "*Sekolah Lapangan*" was introduced from the beginning. Resembling a "school without walls," these field schools meet for 10-12 weeks, i.e., one complete rice-crop season, from seedbed preparation and transplanting to harvest. Each field school has 1000-square-meter learning fields run by the farmers. Each week farmers practice agro-ecosystem analyses, which include plant health, water management, weather, weed density, disease surveillance, and observation and collection of insect pests, beneficial predators. and parasites. Trainers trained by allowing the farmers to be the experts, facilitating them to bring forth and examine their own experience. The introduction of *"Sekolah Lapangan"* or Farmers Field School (FFS) was a decisive effort to educate farmers by encouraging them to observe and analyze and discuss their rice field's agro-ecosystem status on a weekly basis, in such a way that participating farmers would develop their critical thinking through research and discussion among themselves. This different approach of IPM reflected their different approach to extension. Farmers were no longer considered mere passive receivers and acceptors of external recommendations, but as active learners and expert masters in their own field (Van de Fliert, 1993).

Methodological Approach

General methodological approach for this study is mainly to observe, record, and take notes. Interviews with the group while they are doing activities was allowed and provided by the person in charge of running the session.

Observation and interviews with the groups gave me general ideas about how IPM training was conducted. Interviews with individuals were arranged after the group meeting or separately by appointment.

The study features interviews of three progressive or advanced farmers, recognized because of their pioneering efforts, their innovations, or their commitment to share personal IPM experiences with other farmers. Interviews are conducted by the researcher and by a team of interviewers from Research, Education, and Dialog (READ), a non government organization working in the field of popular education. Their interviews with the three selected farmers were following guidelines and interview questions designed by the researcher. These questionnaires are located in Appendix A.

Data Collection Strategies

There are several types of data collection techniques to choose from when conducting qualitative research. These techniques include interviews, observations, artifact analysis, document analysis, discourse analysis, focus groups, and other techniques.

- Strategies and Methods - Strategies lend themselves to certain methods. For example, capturing a cultural process in action (ethnography) requires observation. On the other hand, truly understanding someone's lived experiences (phenomenology) will likely require in-depth interviewing.
- Strategies and Tactics - For each strategy, there are several ways to collect the data. For example, interviews can be conducted face-to-face,

by phone (audio conferencing), over Pic-Tel (or video conferencing), through chat rooms (web conferencing) (Qualitative Research, 2003).

Data was conducted using ethnographic and phenomenological methods, though I did none of the electronic methods applied in this research. Face to face interviews are most commonly used as the data collection technique. This technique is the strongest way to apply the narratives in Chapter 7 where phenomenological methods are applied from writing of the three selected main respondents.

Also, as part of data processing, the triangulation technique and the saturation techniques are used to extract research findings. Both techniques are explained as follows:

- **Triangulation** - Strauss and Corbin (1998) as well as Denzin & Lincoln (2000) stress the importance of triangulating data from multiple sources and techniques. For example, observations might be the driving technique in your ethnographic study, but your findings will be more robust and credible if your observations are backed up by comments that participants made in interviews and evidence found in their artifacts. What reliability is to quantitative research, triangulation is to qualitative research. It is an important ingredient in determining the credibility of the findings. Triangulation can be used not only with data collection techniques and data sources, but also with the investigators e.g., having more than one researcher code a transcript, and theories – exploring the data through the lens of multiple theories and perspectives.

- **Saturation** - In quantitative research, most procedures have a definite beginning and end. In fact, through power analysis, estimates as to the number of subjects needed in order to achieve significance levels for a given set of parameters can be determined. Theoretical saturation is the term used to describe the point at which no new information or concepts emerge from the data and when the themes or theories that have emerged from the data have been well-supported. Even with this guideline in mind, it is still very much a matter of the researcher's personal comfort level, as well as contextual considerations regarding resources and limitations. (Qualitative Research, 2003).

Interviews: Group and Individual

The IPM program coordinator was kind and generous in providing time to interview the group while doing their group activity. Interviews with a number of individuals were arranged either as participants finished their activities or by program administrators who arranged special visits for interviews. Farmers' activities and interviews were videotape recorded. In addition, four group interviews were combined with observation of training activities.

The individual interviews provided in-depth perspectives on how each individual perceives, practices, and apply IK through IPM techniques. The individual's level of confidence regarding IPM practices can be determined through the interviews. While a number of individual interviews were conducted, the in-depth interviews with the three individual farmers were most productive. They provided the most significant data collected. Later, other interviewers trained in social sciences and who speak the local language repeated the interviews with the same three farmers using questionnaires designed by the researcher. These interviews were conducted by “Read” a small NGO in Yogyakarta, doing popular education programs. These interviews clarified, confirmed, and filled in gaps from the initial interview. These comparative interviews provided different insights perfectly suited to using Triangulation methods in data processing.

Observations was the main format or tactic used in this study. Observation combined with interviews allowed important information to flow without much interruption or being reduced through researcher bias. Using active-observation, interviewees were encouraged to tell what they wanted to tell about their involvement in the IPM-FAO program activities. Questions were used for clarification purposes or to refocus the conversation when needed.

The phenomenological approach of this qualitative research is defined as follows:

> **Phenomenology** - Study of lived experiences as they present themselves to consciousness - "the world as we immediately experience it pre-reflectively rather than as we conceptualize, categorize, or reflect on it" (Van Manen, 1990). It answers the question, "What it is that like?" For example, Bargdill (2000) studies the phenomenon of life boredom and describes the lived experiences of several sufferers who have been afflicted by chronic boredom.

- Existential Phenomenoloy - Heidegger (1962)
- Transcendental Phenomenology - Husserl (1931) (*Qualitative Research*, 2003).

Grounded theory, also used in the study, is defined as follows:

> **Grounded theory** - Theories emerge from data that are grounded in reality (Strauss & Corbin, 1998; Glaser, 1992). Its purpose is to build theory that is faithful to the area under study. It answers questions such as: How does this work? What happens during this process? What differences exist among these? What issues are there" (*Qualitative Research*, 2003).

The focal issue of this active-observation is about people's control of their knowledge, especially in keeping and recognizing the knowledge; in maintaining and disseminating that knowledge within the community and between communities.

Taking into account the time available for the study, emphasis was placed on the involvement of social inquiry and educational work with little or no emphasis on the political action. Therefore, the study focuses on the farmers' activities, stories, and the dynamics of their interactions in the field. Large amounts of data from IPM/FAO collection provided much information about the farmers, communities, and their involvement in the program.

This research creates opportunities for participants to control the research process and the production of knowledge, by making them the subjects of the research and, therefore, the center of social change. The development of baseline data, as well as the background information of the study, is supplemented with library research and interviews with members of the communities as well as project administrators.

Although some methodologies and techniques used in this study were modified in accordance with the participants' experiences specifically with their way of knowledge-generation. Among those modifying experiences were the use of popular education and the creativity of local subjects in new agricultural techniques. To make sure those changes would come from within the community; the local subjects were invited to participate in the research process. It was through this dialogue that the community identified their problems and then decided actions to achieve their goals.

It is understood the researcher is not to deliver or to transfer knowledge or power to the people being studied. The task of the researcher in this context is to facilitate the people's own process of recognition and transformation of their own knowledge. The process would thus create self-awareness and bring them to a new understanding of their own knowledge system. It was extremely important to understand the power that sustains their community and their livelihoods.

How Respondents Were Selected

As noted above, the selection of respondents for this study was narrowed to three individual farmer leaders. These farmers had played significant roles in the IPM program and later became leaders in their own communities and regions. They were nationally recognized in their various degrees of farming expertise and often mentioned during interviews with other farmers, farmer groups, IPM/FAO staffs, NGO staff, and even field government staff from the Department of Agriculture.

During the preliminary assessment of various IPM sites in Central Java, farmer groups participated in interviews during their IPM training in the districts of Gunung Kidul, Bantul, and Kulon Progro in July 1995. In the year of 2000, the districts of Magelang and Kulon Progo were included. The three men were mentioned in each district where interviews were conduced. Each man possessed five characteristics and experiences that met the criteria for the study. These were:

- These farmers were known for their leadership roles among other IPM farmers in their villages, both regionally and nationally.
- They were well known farmers' trainers and had been invited to conduct various IPM training sessions.
- They had presented their research and shared their experiences in various farmers' regional and national meetings.
- They had also been invited to a number of state and private universities to present their ideas to academic communities.
- These farmers had experienced various known systems of agriculture: the traditional, the Green Revolution, the IPM and the organic agriculture.

Each man represented the communal wisdom of at least ten farmers' groups and if there were thirty members in each group, each one could represent at least

300 farmers of their areas. Thus, the seemingly modest choice of only three farmers, developed into a very large and complex mechanism for research.

Preparation for the study

In addition to knowledge of Indonesian society and communities, established relationships with organizations that have interests in the indigenous knowledge system, were necessary criteria for conducting the study. The organizations, including, among others, IPM/FAO, READ, and INSIST. Individuals in these organizations have provided an indispensable support necessary for carrying out this research. The IPM national coordinator from the National IPM Program office, for example, provided manuscripts, reports, reading materials, and video tapes prior to conducting this study.

The Role of Researcher

Borrowing from anthropological methodology, the researcher took on the role of active observer, as opposed to the traditional "participant observer." This anthropological approach allowed farmers and the people of the indigenous communities, and other research subjects, the freedom to tell their stories, describe their techniques, and express their feelings.

Concepts of participatory research combined with collaborative education, research, and action, were applied. This study also deals with the role of popular education in the social transformation of communities by describing how people sought to advance indigenous knowledge to improve their living conditions. In this process, both the researcher and the subject of the research learn from one another.

This research, therefore, should not be viewed solely as an academic inquiry, but should also be considered as part of the actual process of social transformation. All involved were committed to social change. The results and outcomes of this research will have some impact on educating both the general public of Indonesia and governmental officials about the importance of recognizing the indigenous knowledge system in promoting their agricultural development programs.

In short, I took the role of participant and associate myself with the people, the subject of my study. This provides space for participants to engage in genuine dialogue, identify their goals, and become aware of their commitments. This dialogue will stimulate the critical consciousness of the participants as they continue their struggle for a just income without degrading their land and the environment.

Selection of Sites

Sites for this study were chosen from two rice-producing provinces of Indonesia: Yogyakarta and Central Java. Yogyakarta was one of the first IPM sites where the program was launched in 1986. Yogyakarta is unique in that it has a status as Special Territory for Yogyakarta. It is considered special because it is the seat of the sultanate of Yogyakarta, an old kingdom, where the current Sultan (king) still reigns as the Governor of this special territory. The Special Territory for Yogyakarta enjoys status equal to a province. Central Java is another province which surrounds Yogyakarta. The IPM program in Central Java was the expansion from the successful phase one in Yogyakarta.

From these two provinces two sub-districts were chosen. The site selection was decided in consultation with the National IPM Program Office in Jakarta and IPM regional director in Yogyakarta. Visits to communities and IPM Farmers Filed Schools were arranged with local IPM field staff. The field staff arranged my day-to-day visit and interviews. The IPM field staffs were very helpful in identifying and matching my research needs with farmers or community availability.

Data Gathering Techniques

As previously mentioned, this study primarily uses the technique of active-observation. This technique of data gathering may be defined as a combination of observing, listening, and taking notes with clarifying questions. I include this technique as one of participatory research which primarily employs *dialogue* as a method of gathering data. It approximated the well-known anthropological method of “participant observation.”

I also used videotaping to record activities and interviews. I was using a very easy to operate handy-cam. As I couldn’t operate the camera and conducted the interview at the same time I normally asked one of the farmers to do the recording while I am doing the interview. After spending about five minutes teaching the camera operator on how to use the camera they proved quite adapt at taping the interview.

A number of techniques were used to gather data while maintaining the principle method of active-observation. The following are some of these techniques:

1. Rapid Rural Appraisal (RRA) is a method of grassroots research used to identify the problem, goals and strategies of households, groups, and communities. It is devised to meet development-oriented research when data collection has to be made in a tight period. RRA rapidly scans the situation of communities and provide rough impressions of issues and problems dealt by a community. Although it is only a skin-deep, RRA gives an idea about what is going on in the village.
2. Observation field notes were used early in this research process, especially during the exploratory phase. Observation field notes are used to get a general impression about the community. These notes record demographic data, visual impressions, and the general environment of the community. This observational activity was conducted in a manner similar to Rapid Rural Assessment or was done in conjunction with the rapid rural assessment activities.
3. Meetings reflect the community's daily concerns and interactions. I always request permission to take notes at community meetings. I also was careful to request permission to record them with audio and video equipment. In meetings, I normally sit as a guest in the corner after I made my introduction to the group and state my purpose in conducting

this study. I also checked that none of the member of the meeting objected to my presence and purpose of being there.

4. Interviews were done with selected interviewees who had who were farmers before Green Revolution, during the Green Revolution, currently apply the IPM farming techniques. The interviewees also practice organic farming. Interviews were conducted in informal settings combined with home visits or seeing them while working in their rice fields. Interviews were videotaped. Interviewer was hired to conduct interviews with the same farmers using the questionnaires developed by the researcher. Please refer to the questionnaires in Appendix A.
5. Document analysis is very important during the initial phase of this study. The National IPM program office provided me with various IPM project documents consisting of: progress reports, training activities, farmer Field School activities, academic papers, farmers' science meetings, and farmers' research. These documents provided useful quantitative data, illustrations, and narratives about the IPM project.
6. Internet Document Resources is another resource I found very exciting to explore. Using one of the best internet search engines like www.google.com, I was able to gather much good information, as well as links to a number of websites that provide very good data. I used the Internet from the very start of my project.

The above methods of data gathering were used interchangeably to adapt to appropriate situations. Observations, interviews, meetings with community and staff of implementing agencies are done and scheduled with the consultation with IPM field staff. The National IPM Program Office graciously provided a car, a driver, and field staff to support the research.

Time Plan

The initial contact with IPM program sites in was done in the summer of 1995 when much valuable data on farmers and farmer activities was collected. Data collected through video recorded interviews provided a very good picture of many active IPM training activities. During this time the 10 years IPM program activities were running at full speed.

Additional data was collected in May 2000 and June 2001. During these visits, significant data was collected on post IPM training farmers' activities. This time period was near to the closing of National IPM program, which happened in 2002. Data collected during this time period shows many farmers' leading activities, innovations, research; and expertise. During this time period, reports on farmers' science meetings and on the IPM farmers Association were analyzed. That association voiced concerns of the farmers in the national forums. In doing so, they influenced Indonesian national agricultural policy.

In August 2002, extensive questionnaires were developed and sent to a village promoter who worked for Research, Educate and Dialogue (READ), an NGO doing popular education campaign and advocacy in Yogyakarta. The promoter has a background in sociology and experience in conducting interviews. She conducted interviews of the three assigned farmers. The purposed of hiring an interviewer was to get a comparative view from another interviewer, to fill in the missing historical data from my previous interviews, and to compare interview notes. With the questionnaires, the interviewer was able to conduct more structured interviews of the three leading farmers. Please see copy of the questionnaires in the Appendix A section.

Data Processing

This study is qualitative research that follows the canons of modern social science. One of the characteristics of this study is that arguments are not proven with significant quantitative data. The overall data processing was done through selection of qualitative data: observation and interviews notes watched the videotapes and started to group the collected data according the following categories:

1. Data with significant importance
2. Data with less significant importance
3. Regular or commonly available data

The differences of the above classifications are as follows:

- Data with significant importance is information provided by interviewees. This data appeared a number of times, repeatedly mentioned or mentioned with a strong emphasis.
- Data with less significant importance is information provided by interviewees, which appeared two or three times or was mentioned with some emphasis to indicate its importance.

- Plain or regular data is information plainly mentioned by the interviewees. Plain data mentioned by a number farmers or interviewees indicates some level of importance. This kind data normally has become public knowledge of the people involved in the related issues.

Processing notes and other data, applied triangulation and saturation techniques, are part of an integral aspect of the collection strategies (see above, pp 112-114).

Strong designs for data collection was a key to good outcomes. Assumptions used for building this research project were important in setting up the direction this research should follow and determined the research questions. I think it would be relevant to mention what I learned from this research process:

1. Research on Indigenous Knowledge Systems (IKS) is an iterative process of defining the purpose and asking appropriate questions, in order to collect information that is useful in answering the research questions. Kinsey's famous statement, "Who wants to know what and for what purpose," was accurate?
2. Research is ongoing process of asking questions to reveal the truths. Keep in mind that this revelation of truths is partial, and timely-spatial in its context. A "truth" is different for different times and or different locations. It is always wise to try small-scale applications of any research findings in different times and different location to check reliability of claims before applying them on a larger scale.

3. Indigenous Knowledge Systems (IKS) researches are assertions of reclaiming control or local knowledge, of local or indigenous communities reacquiring control from the domination of the universal knowledge hegemony. IKS researches are therefore an empowering process by and for the local/indigenous communities to regain control over the ownership of their own knowledge. This is not something I learned as a bias (see my discussion of bias above, p. 105-107). I was able to confirm by research.

CHAPTER 4

THE STRUGGLE: INTEGRATED PEST MANAGEMENT VERSUS THE GREEN REVOLUTION

Introduction

This chapter discusses two contesting ideas: of the agricultural practices of the IPM and the farming approach of Green Revolution. Between the inception of the IPM system (1986) and the inception of the Green Revolution (1948), there is a 38 year stretch of time that allowed people to reflect about the Green Revolution.

The Wave of the Green Revolution

The introduction of the Green Revolution to Indonesia happened in the late 60's as a part of international wave of agricultural modernization to developing nations. This program aimed at increasing developing nations' food productivity by means of transferring advanced agricultural technologies. At the same time, developed nations channeled financial assistance in the form of loans to poor countries to overcome external food dependency. Many of developing nations' governments bought into this concept of food security. The idea of feeding the nation was very attractive to many developing nations' leaders and to policy makers throughout the world. Backed by bilateral and multilateral loans provided through the World Bank and The International Monetary Fund, the two world's largest financial institutions, the Green Revolution programs around the world thrived for about four decades.

Indonesia and almost all developing countries around the world, with the exception of China[4], adopted the Green Revolution approach in their national agricultural program. The Green Revolution offered farmers package-deal approach. This package deal could include in a credit schemes that provide high yield variety seeds, inorganic fertilizers, pesticides, growth hormone, herbicides, and even some cash to pay for the labor. Government commonly provided predetermined credit package for farmers based on acreage of their cultivated land. In the early period of this program's introduction in Indonesia, farmers were not given the chance to opt out from participating in this program. In many places in Indonesia, there were stories of farmers being instructed, intimidated, and even forced to take part in this national program. The Indonesian name for this program was BIMAS, short for Bimbingan Masa, which literally means mass guidance. The name reflects efforts by the government to guide the agricultural mass, the farmers, in optimizing their food production capacity. The Department of Agriculture promoted and conducted this top-down program by forcing farmers to follow government instructions in their farming activities.

General Soeharto in 1965 initiated the Green Revolution in Indonesia right after the military coup from Sukarno, the first Indonesian president. Soeharto succeeded Sukarno and stayed in power for the next 36 years, until 1997, when the people forced him to step down. The military government of Indonesia silenced and banned the Indonesian Communist Party (PKI), the largest political party of the nation at that time, by accusing them of a coup attempt. The Indonesian military crushed the Communist Party by killing its members or

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[4] China was occupied with its own revolution, the Cultural Revolution.

sentencing the to jail or concentration camps. Many were prosecuted without proper judicial procedures. Though the estimated casualties were between 600,000 and 1,000,000 people, nobody knows how many were kidnapped, tortured, and murdered during this blood bath period. The government of Indonesia under the leadership of General Suharto intimidated farmers who refused to take part in BIMAS program by accusing them of being associated with the Communist Party. The BIMAS program used iron-fisted approach toward the farmers especially during this dark period of Indonesian history. Farmers were afraid to raise their voice or resist the program. They had to meekly follow and take part in the program.

The Purpose of the Green Revolution

The stated purpose of the Green Revolution is to alleviate world hunger, in reality, it became corporations dominating farming and creating massive dependence to fuel based chemicals. In the early 1980's, agricultural experts launched critiques that questioned the environmental impacts of the Green Revolution agricultural practices.

At the same time, nations of the world experienced massive increases in food productions, yet, Norman Borlaug's—the founder of the Green Revolution—hypothetical assumption was not met. The abundant food productions around the world were matched by wide spread starvation and famines around the globe. The success of the Green Revolution in quadrupling food production has came with a very high price tag in the forms of significant environmental deterioration, massive social cost to farming communities around the world, degradation of individual and family health of the farmers, as well as the food that consumers bought and consumed are contaminated with pesticides and other chemical residues. The answer to the world's hunger problem is not a simple equation of world hunger balanced out by food productions.

The Green Revolution and the Environment

By late 1980's, the Green Revolution was known to cause significant damage to farmers and the environment, mainly through pesticide application, the use of generous chemical fertilizers, and the disregard of environmental safety. Many environmental impact assessment studies suggest that the Green Revolution caused harms to humans in addition to the environmental. It was a disaster for the environment and a disruption of the ecological system. Pesticides used were mainly organophosphate based chemical compounds found in pesticides products such as Diazinon. These poisoned the surrounding air, soil and water. *Organophosphate* based pesticides, which work through paralyzing parts of the nerve systems which is called *cholinesterase* inhibition. *Cholinesterase* (ko-li-nes-ter-ace) is one of many important enzymes needed for the proper functioning of the nervous systems of humans, other vertebrates, and insects. Certain chemical classes of pesticides, such as *organophosphates* (OPs) and *carbamates* (CMs) work against undesirable bugs by interfering with, or 'inhibiting' *cholinesterase*. While targeting insect pests for the effects of *cholinesterase* inhibiting products these chemicals can also be poisonous, or toxic, to humans in some situations (EXTOXNET, 1993).

Pesticides produce a wide range of the killing spectrum. Besides killing destructive pests, pesticides also kill all the benefiting enemies of the pests. They kill fish and other small farm animal like chicken and ducks. They poisoned the cattle and the small ruminants (sheep, goats), as farmers feed the straw from the harvested crops residues.

Pesticide poisoned those who applied them, because most farmers cannot or do not read the safety application procedures, which usually are printed poorly and hard to read. Poisoning was rampant. It was common to see farmers carelessly applying or spraying pesticides wearing no mask or while smoking cigarettes. Mixing, preparing and handling pesticides with bare hands, wearing no gloves or other protective equipments like breathing masks, protective capes, goggles, and caps. Pesticide poisoning happened through contact with skin, and mucous membranes of the body like eyes, nose and lungs. The bottles, though are clearly marked to be destroyed or buried, were often reused for other purposes. Sometimes pesticides containers were even used for keeping food-related home products like cooking oil.

The Farmers' misconception in their understanding of pesticides as "medicine" for their crops, rather as poison, made them careless in handling and applying these pesticides. Symptoms of poisoning ranged from severe skin rashes, nausea, headaches, vomiting, to losing eyesight, and shaking and paralyzing of the limbs and other muscles of the body. Some victims of pesticides poisoning are not able to speak properly as they are unable to move their lips and other facial muscles. A video program released by FAO/IPM shows various victims of pesticide poisoning. The misconception of pesticides as medicine for plants completely misleads farmers to understanding the level of toxicity every pesticide compound may contain.

Inorganic fertilizers applied in the field penetrated ground water and streams. It contaminates bodies of water, enhances excessive algae and water plants growth. This disproportionate growth of algae and water plants blocks irrigation canals and weirs.

The phosphors leached out from phosphate based fertilizers ties the oxygen in the water, which causes the lower biological oxygen demands (BOD). Phosphor (P_2O_5) as an active ingredient of PO_4 or phosphate compound is easily reacts with oxygen in the water and bind the Oxygen molecules, this situation makes fish and other water living animals to difficult to breathe.

These chemicals and pesticides are carcinogenic compounds. Prolonged and frequent contact with these materials will increase the risk of cancer to applicator farmers and the consumers of the produces.

The Green Revolution and the Agricultural Extension System

Green Revolution practices began with the invention of the miracle seeds that are highly responsive to nitrogen fertilizers. These seeds are capable of producing quadruple amount of harvest in well-controlled fields where there is water, (chemical) nutrients in abundant quantity, and controlled weeds and pests. The Green Revolution employed agricultural extension approach using top-down passing of information. Farmers were treated as passive recipients of the agricultural knowledge. Using an analogy of a doctor prescribing medicines to his patient, so did a government extension agent prescribing instructions to the farmers about things to do about their crops in their land. This extension approach discouraged critical/creative thinking among farmers.

During the Green Revolution era, farmers were to report to pest surveillance staff from the district agricultural office. And upon checking on the farmer's rice field, the staff person will report to his or her boss. The office will analyze the problem and then instruct the farmer on what to do to remedy that pest problem. The problem with this kind of field consultation by pest surveillance staff is that many, if not all, surveillance staff have a side job as pesticides company formulator agent. As formulator or agent of the pesticides manufacturer, pest observant staff receives some additional income simply by referring a solution of using any specific pesticides products made by the company he is representing. This double-hats function of the surveillance staff is clearly a conflict of interests. Any report filed by farmers will be responded to with suggestions to apply a certain brand of pesticides. Many times farmers have had to pay quite dearly for the price of a certain brand of pesticide because that specific brand is not included in the agricultural credit package.

The agricultural techniques refined and developed by the Green revolution utilized mechanized and fuel based technology, and which are foreign and unaffordable to subsistence farmers. The Green Revolution technology consists of the following:

1. **Extensive use of chemical fertilizers** - Every plant basically relies on several basic compounds in order to grow. Nitrogen is highly needed and supplied with urea. Phosphates (P) and Potash (K) element are important, as well as numerous trace elements. Soil pH (acidity or alkalinity) must also be adjusted to the optimal conditions of the crop. In reality farmers were encouraged to use chemical fertilizer generously.
2. **Irrigation** - Although irrigation has been in use in agriculture for thousands of years, the Green revolution further developed irrigation methods to allow for more efficient irrigation. To serve for this purpose, many major dams were built around the world. People pay a high price on any big Dam projects as it dislocates people from their land, and changes the natural trail of water, which could cause negative impacts on wildlife.
3. **Use of machinery** - Mechanization applied with the Green Revolution resulted in a drastic reduction in the input of human labor on agriculture by extending the use of machinery to automate every possible agricultural process. Use of heavy machineries was considered inappropriate in the Indonesian context due to the sizes of plots. However, small machinery like hand tractors, rice threshers and rice-huller were used more intensively.
4. **Pesticides and herbicides** – chemical pesticides and herbicides are used to control pests that could damage the crops and annihilate weeds that compete with the crops. Herbicides were not commonly used in wet-

land or paddy rice farming. (Wikipedia, www.wikipedia.com ,the online reference)

Green Revolution and Its Broken Promises

Dr. Norman Borlaug research finding in early 1960—marked the inception of the Green Revolution—when he found the Mexican wheat varieties that produces 400% more than average when treated with nitrogen. He claimed that the Green Revolution was the solution to the world's hunger. This claim did not stand as the more countries of the world adopted this system of agriculture, and are able to make dramatic increase in their food production, problems of hunger lingers.

This problem was clearly stated by Peter Rosset, the co-executive director of Food First/The Institute for Food and Development Policy, in his research based article presented in World Hunger: 12 Myths, stated that hunger alleviation effort should not focus on producing the amount food needed to feed the hungry but more on creating equitable access to food production. Further, In his article Lessons from the Green Revolution—Do We Need New Technology to End Hunger?, published at Tikkun Magazine, vol. 15, no. 2, in March/April 2000, Rosset mentioned China was more successful than any country in the world in cutting down the number of their hungry people. China's Cultural Revolution that gave broader access of land to Chinese poor was able to cut the number of hungry to less than half, from 406 millions down to 189 millions (Rosset, 2000).

At the same article, Rosset pointed out reasons that prohibited the Green Revolution from achieving it own goals. Rosset further explains this anomaly in the four following reasons:

Whether the Green Revolution or any other strategy to boost food production will alleviate hunger depends on the economic, political, and cultural rules that people make. These rules determine who benefits as a supplier of the increased production-whose land and crops prosper and for whose profit-and who benefits as a consumer of the increased production-who gets the food and at what price.

With the Green Revolution, farming becomes petro-dependent. Some of the more recently developed seeds may produce higher yields even without manufactured inputs, but the best results require the right amounts of chemical fertilizer, pesticides, and water. Therefore, as the new seeds spread, petrochemicals become part of farming. In India, adoption of the new seeds has been accompanied by a six-fold rise in fertilizer use per acre. Yet the quantity of agricultural production per ton of fertilizer used in India dropped by two-thirds during the Green Revolution years. In fact, over the past thirty years the annual growth of fertilizer use on Asian rice has been from three to forty times faster than the growth of rice yields.

Because farming methods that depend heavily on chemical fertilizers do not maintain the soil's natural fertility and because pesticides generate resistant pests, farmers need ever more fertilizers and pesticides just to achieve the same results. At the same time, those who profit from the increased use of fertilizers and pesticides fear labor organizing and use their new wealth to buy tractors and other machines, even though they are not required by the new seeds. This incremental shift leads to the industrialization of farming.

Once on the path of industrial agriculture farming costs more. It can be more profitable, of course, but only if the prices farmers get for their crops stay ahead of the costs of petrochemicals and machinery. Green Revolution proponents claim increases in net incomes from farms of all sizes once farmers adopt the more responsive seeds. Nevertheless, recent studies also show another trend: outlays for fertilizers and pesticides may be going up faster than yields, suggesting that Green Revolution farmers are now facing what U.S. farmers have experienced for decades-a cost-price squeeze (Rosset, 2000).

Integrated Pest Management Program

Integrated Pest Management (IPM) is a method of farming without or with a minimum use of pesticides. The whole new concept of “let nature takes care of it self” encompasses all the main techniques of the IPM approach in agriculture. In nature, pests have enemies that prey on them. Nature creates ecological balance between pests and their enemies. Pests and their enemies in an ecological system co-exist in equilibrium. Pests’ enemies will prey on those organisms destructive toward the crops. These pest enemies control the level of pests’ population into safe ecologically balanced mechanism so that only insignificant damages to the crop occur. In Indonesia IPM is mostly applied to the country’s main crop, rice.

IPM is considered to be the main alternative to the Green Revolution program of controlling pests that damage crops and ruin harvests.

Integrated Pest Management (IPM) program attempted to address the failures of the Green Revolution. IPM program is a program sponsored by the Food and Agriculture Organization of the United Nations (UN/FAO) that supported the Green Revolution during its massive campaigns in the late 1960's. However, the IPM program emphasized the importance the power of nature to take care of itself in a balanced equilibrium. IPM believed in returning power to farmers, actors, and implementers of farming systems of the world and putting them back in the manager seat of their own farming activities. IPM program empowered farmers by building critical thinking skills, encouraging them to ask questions, and to make smart decision in running healthy and environmentally safe agricultural activities. IPM opened the door to the reinvention of many indigenous agricultural practices that were otherwise buried deep down in the history of the humankind.

The use of pesticides has broad-spectrum effects, because they indiscriminately kill every organism on contact. Thus, broad-spectrum pesticides kill beneficial insects that prey on the pest—the pests' enemies—as well as the pests. In addition, studies found that insects can, by mutation, develop resistance to toxic substance and thus survive pesticides application. This level of resistance increases over time to a point where the pesticides will no further affect them. The poisons, formulated as the main active components of the pesticides, then become ineffective in doing their job of controlling the pest population.

In 1986, the Food and Agriculture organization (FAO) introduced the IPM concept, the non-toxic alternative, to Indonesia during the time of repeatedly occurring brown-plant-hopper outbreaks in many of Indonesia's rice bowl areas. These outbreak occurrences related significantly to the abuse of pesticides use. Studies suggest that excessive use of pesticides created an imbalance in the rice field ecological system. Harmful aspects of this imbalance were the development of mutant insects that were able to survive poisonous environments, and the extinction of pest enemies, which prey on those pathogenic insects. Arbitrary pesticide application using calendar spraying destroyed the equilibrium between those insects and their enemies in nature. Pesticide spraying is considered to be the major cause for pest outbreaks.

Brown Plant-hopper Outbreaks

There were a number of cases of pest outbreaks around the world because of over-use or abuse of pesticides. A notable example was the brown plant hopper (BPH) outbreak in Indonesia's Java rice-bowl area in 1978, which wiped out the rice crop for three sequential cropping seasons. Farmers in that area traditionally produce abundant rice harvests of an average four M/Tons per hectare minimum. During this outbreak they harvested literally nothing. The brown plant-hopper attacks the rice crop when it is near its maturity, i.e. during flowering period. These outbreaks caused significant loss to farmers, as they had to put all their working capital into buying agricultural inputs, while at the end they collected no harvest.

Java, one of the largest and most densely populated islands of Indonesia, with population over 50% of Indonesia's 220 million the largest rice-bowl area for the country. Because Indonesian farmers are mainly subsistence farmers, only a little of their surplus will make a cash profit. The BPH outbreak devastated the area; farmers did not know what to do about their farming activities, their livelihood, and surviving on their own land. When this outbreak happened in 1978, farmers sold their land cheaply and tried to sell anything valuable in order to buy food. This experience turned around the way agricultural communities look at the problems.

It was ironic that farmers living in this rice-rich area were suffering from starvation. This reality shocked the country and stunned policy makers. Every one tried to solve this puzzle: What caused the outbreak? For the Indonesian Department of Agriculture, this was confusing. Simple logic would simply conclude that when there are more pests in the field then more pesticides spraying is needed. The government increased the number of field pest surveillance team and more pesticides were supplied, free of charge, in government subsidized package to safeguard and protect the ailing rice-crop, the staple food for Indonesians. This ignorance continued until 1986, when Suharto, the president of Indonesia announced IPM decree that banned 56 brands of pesticides for application on rice. This presidential decree recognized the damage caused by arbitrary pesticides applications and the direction of

Indonesian rice production centering in the importance of ecological balance. This decree also gave birth to IPM program in Indonesia.

Introduction of IPM in Indonesia

After a long debate about the cause of outbreaks, policy makers were finally agreeing that abusive application of pesticides was the major cause of the outbreaks. This resulted in 1986 regulation of pesticides sales and application. Indonesian Presidential Decree number 3/1986 supported and initiated the IPM concepts and practices, stating:

1. Pesticides are only to be used when other methods of pest control have proven ineffective; specifically when the pest population exceeds established economic thresholds.
2. Type of pesticides utilized and their application methods must take into account the maintenance of natural enemy populations.
3. Pesticides, which might cause pest resurgence, resistance, or other damaging side effects, are therefore illegal and forbidden.

This decree was immediately took affect and 56 pesticides prevalent on the market at that time were banned, primarily the *organophosphate* (OP) based pesticides, which were found to have wide spectrum effects, literally killing everything when they were sprayed. The Indonesian government cut the pesticide subsidy to the farmers. This was a drastic policy change as pesticides were normally inserted into the agricultural loan package, a must to the farmers' credit scheme. This policy action is estimated to save the country an average of 120 million US dollars every year. For farmers, losing the subsidy would mean a much higher price of pesticides in the market place. With farmers' economic inflexibility, any slight increase of price would cost farmers' ability to purchase pesticides at the market's price. This is exactly the target of that policy change i.e. the cutting of the pesticides subsidy will significantly reduce the field application of various OP based pesticides.

Research conducted during 1979 - 1986 found that indiscriminate application of pesticides targeted at eliminating of the rice brown plant-hopper, also destroyed the beneficial local predators of rice-feeding insects. Agro-ecological studies identify many natural enemies of rice pests, among those are wolf spider (*Lycosa pseudoannulata)* from jumping spider family (*Salticidae*), dragonflies and damselflies families (*Odonata*), ladybird beetle or ladybugs (*Coccinellidae*), praying mantis (*Carolina Mantids*), and many others. Jumping spiders (Salticidae) are the main enemies of brown plant hopper, easily distinguished from other spiders by four big eyes on the face and four smaller eyes on top of the head. Around the world, there are probably more than 5000 species of jumping spiders (Madison, 1994-1995).

One major strategy of IPM was to encourage the growth of these enemies population by simply not applying pesticides in the fields. Some organisms, like fungus could also be used for natural pesticides or fungicides so no chemicals were left behind, unlike inorganic pesticides. Fungus species such as the *Beuvaria bassiana Sp*. are effective in controlling BPH. BPH infected with *Beuvaria bassiana* will show white or green mould on their body in about 3 days then it will die. Dead BPH can be collected and used for ingredient in making natural pesticide to control BPH.

Trichoderma sp., another species of fungus is also effective in controlling *Fusarium* fungus. *Fusarium* fungus known to cause leaf rots and root rots. *Fusarium* infections in crops cause blight (scab) in wheat and barley and other cereal crops and produce deoxynivalenol (DON) in these grains. Two *Fusarium* mycotoxins, *fumonisins* (Fm) and DON are the most frequently detected and, therefore, most often associated with illness in farm animals and humans. *Fumonisins* cause a neurological disease, and esophageal cancer in humans in villages in India who had consumed corn tainted with *fumonisins* (Doyle, 1997).

The IPM/Indonesia experience started with small-scale training between 1986 and 1988 and later developed into a full national program in1989. IPM proved to be the most cost-effective way for rice producer in Indonesia to control these pests using the alternative methods which discouraged the use of pesticides and encouraged the benefits of natural pests' enemies to control the pest population. In time this method controlled the unrestrained growth of noxious pests.

Farmer Field School the key IPM training

Introduction of IPM program in Indonesia would not be possible without massive education campaigned using the Farmer Field School IPM training. FFS/IPM was introduced to farmers using democratic, adult educational approaches that respected farmers' experiences. This system of learning also known as, non formal education system (NFE), encouraged shared learning and reflections of group activities. In the IPM training setting, individuals learn within a group. All major IPM training components employed group activities. These components are field observations, analyses of agro-ecological system of the crop, decision making, exploring of new knowledge, and, finally, planning of a group action.

As a result of field observations farmers learn during Farmer Field School of IPM (FFS/IPM) training, farmers began to understand the pests' relationship with their enemies and their surroundings in the rice fields. This training revolutionized the farmers' understanding of their own farming activities. Farmers became critical of their own practices. Most importantly was the finding that the generous application of pesticides create the opposite effects of what they expect as pests become resistant to pesticides and the imbalance created major pest outbreaks, destroying their crops. FFS/IPM education training had become the major critical point in building educated decision about farming practices to millions of IPM converted farmers. This educational component become the core focus in this dissertation study, because without the FFS/IPM non formal education (NFE) system, all the educated discussions and decision making involving the IPM practices would have been impossible.

The Liberating Field School Concepts

The change started in 1989 with the switch from the mass campaign and instructive program approach to the community based education approach. For four decades, during the intensive agricultural program campaign of BIMAS, inundated Indonesian farmers with information, instructions, subsidies, and agricultural credit packages program provided by the Department of Agriculture. This version of Green Revolution campaigned intensively with the sole purpose of optimizing agricultural productivity for major crops around the world. Farmers are considered as recipients of the program and were tied into following instructions concerning their farming activities.

From beginning of IPM program in Indonesia introduced the concept of "*Sekolah Lapangan,*" which means field school. The concept of field school was built up with strong non formal education ideas, focusing on the adult farmers' population, which is mostly uneducated or minimally educated. The field school employed a number of progressive adult education techniques, including group discussions, simulations and games, role plays, even cultural performances which trigger a follow-on discussion on the presented topics. Many of Freire's consciousness raising concepts and techniques were also applied in the field school learning activities.

The school resembles a "school without walls" where a group of farmers meets frequently from the beginning of cropping season to harvest, for a period of 10-12 weeks. Each field school has 1000-square-meter learning or practicum fields run by the participating farmers. Each week, farmers meet in the rice field and practice agro-ecosystem analyses. These agricultural and ecological combined analyses include the discussions, which include plant health, water management, weather calculation, weed density, disease surveillance, and observation. The school activities also include collecting insect pests, beneficial predators, and parasites. (Van de Fliert, 1993)

The IPM trainers train farmers by allowing them to be the experts, by encouraging them to bring forth and examine their own experience. Reviews of farmers' own perceptions and experiences are crucial in bringing them forward to the new understanding of the agro-ecological concepts which are the core of IPM awareness. It also motivates farmers to think about their own actions and calculates all the consequences, before they act. This different approach of IPM reflects significant difference in the approaches to conventional agricultural extension services. The Department of Agriculture extension services employed top-down instructive approaches to farmers. In IPM farmers are no longer considered as passive recipients of acceptors of external instructions and recommendations, but as active learners and expert masters in their own field (Van de Fliert, 1993).

Learning the IPM Techniques

To learn the IPM techniques, farmers need to be involved in an active learning process where they are in charge of identifying their learning needs based on the day-to-day problems they encounter in their own fields. No predetermined curriculum is applied in the farmers training of IPM practices. The IPM experts have to put themselves into the whole learning process and facilitate a series of process including problem identification or need assessment, problem solving, and implementing a set of actions necessary to overcome problems encountered in their fields.

IPM techniques encourage the recognition of ecological relationships between pests and their enemies. Then, based on this understanding, farmers will determine their actions, which may include decision not to do anything. In many cases, the new understanding will suggest that the presence of pests in their rice fields is in an ecological balance with the presence of their predators. For example: ten brown plant hoppers in one rice cluster will be judged as safe if there is a jumping spider nearby. A hungry jumping spider can easily consume about 10 brown plant hoppers in a day. So the appropriate decision will be: do nothing. During the Green Revolution, the pest observer would easily raise a red flag, and dispatch a spraying order to the field without consulting the farmers.

Elske Van de Fliert in her paper *Integrated Pest Management: Farmer Field School Generate Sustainable Practice—A Case Study In Central Java Evaluating IPM Training*, submitted to Wageningen Agricultural University in The Netherlands in 1993, mentions that the IPM training in the Field School follows a number of specific guidelines and practices. These guidelines and practices include:

1. A field school consists of twenty-five farmers selected either from one farmer group or include member from other farmer group from the same village;
2. Farmers work in subgroups of five, which the optimal size according to Non Formal Education (NFE) principles. This principle is also known as non-classical adult education or andragogy. It is basically recognizes the adults learning approach where learning relates to their life experiences, by using the field setting instead of a classroom, and encourages dialogue rather than simply instructions.
3. Training starts with a pre-test and ends with post-test of knowledge.
4. The field-school lasts the entire season, so that farmers can work with each stage of rice plant development.
5. Each field-school group has a demonstration field, consisting of an IPM plot where IPM principles are used to take pest control decisions.

6. There is hardly any lecturing during the training. The pest observers have been carefully trained not to allow themselves to be forced into the position of expert, but to be facilitator of the learning process.
7. Farmers meet somewhere in or close to the field under a tree or in a small shack which provides some shade.
8. The primary activity is to step into the demonstration fields in groups of five and observe samples of rice hills, usually chosen at random along a diagonal across the field. Notes are made of insects, spiders, damage symptoms, weeds and diseases, observed at each hill. The growth stage of the plant is carefully observed, and the weather. Interesting insects and other creatures are caught and placed in small plastic bags.
9. In subgroups, the observations are put and shared in drawings, the agro-ecosystem-analysis. A leaflet with pictures of pest insects and natural enemies, distributed to each subgroup, is used as a reference. The group draws a conclusion about the status of the crop and possible control measures.
10. The subgroup's agro-ecosystem analysis is presented to the whole field school group. The conclusion drawn from the field observation with respect to pest control is discussed with the entire group.
11. During each session, special subjects are introduced. The trainers' training provided the pest observers with a substantial repertoire of carefully developed training modules.
12. Group dynamic exercises enliven the field school and create a strong sense of belonging to the school.
13. Farmers often keep an "insect zoo", plastic netting around four bamboo poles set around a rice plant. Inside this insect-zoo, various pests and predators are introduced and watched by farmers.
14. Active group members are encouraged to train other groups. This farmer-to-farmer training is an important strategy for mass replication.
15. A field day is organized at the end of the season in which the result of the farmer field school is presented to the surrounding community, including village and sub-district heads in order to obtain (financial) support for follow-up activities. (Van de Fliert, 1993).

FFS/IPM training is discussed in detail in chapter 6.

IPM Agricultural Approach

The IPM approach combines a laboratory process that takes place in the field with references to traditional practices and indigenous knowledge, and facilitates a farmer controlled decision-making process based on their analysis of the problem they find in the fields. This process put farmers in charge of the farming activities. Through IPM approaches farmers are trained to make intelligent decision about their own fields. IPM approach uses much group decision approach, but every single farmer in that group is independent and so responsible for his or her own decision. This was something that during Green Revolution era was highly discouraged. During this period farmers were purposefully made dependent and submissive to government instructions and campaigns. They were not allowed to think and take charge of their own farming activities. Even when there was certain information, this information were purposefully hidden or made inaccessible to them.

In 1989, the government of Indonesia initiated one of the most aggressive IPM programs ever undertaken. This program involves 1000 Pest Observers, 2000 Field Extension Workers and 100,000 farmers to be trained over three years. Involving several government ministries, FAO was invited to form a training team and make a separate bilateral agreement between FAO and the Government of Indonesia (GOI). The United States Agency for International Development (USAID) supported the program with a special policy support grant that would allow unusual freedom of implementation to GOI related ministries.

All of this preliminary research and legislation created a protective shield for action at the farmer level in the field. The main challenge of the program was basically to change farmers' knowledge and practices, which had been inundated by the Green Revolution ideas for over two decades. With IPM farmers were once again encouraged to recognize their old environmental-friendly ways of farming practices. Old and traditional practices brushed off during the Green Revolution era as obsolete and non-productive, are now back in fashion and today the farmers are in many ways in control of their farming activities.

IPM versus Green Revolution

The IPM training approach as applied in the IPM national programs of Indonesia is liberating to the farmers. By contrast the 4 decades of the Green Revolution relied on top-down, iron-fist approaches that demobilized farmer's freedom and curtailed their critical thinking which is necessary for managing their own farms.

For most subsistence farmers, flexibility on expenditure is very limited. The Green Revolution approach compensated farmers' inflexibility with credit schemes and other government facilities such as provision of irrigation canals, extension agents to reach out to farmers and help them apply the new technologies and pest observers to assure that pests are well controlled long before it become an outbreak. This heavily loaded assistance to farmers became a burden to the farmers. They were no longer as free agents in doing their own farming practices.

In the IPM context, farmers become independent operators and "boss" of their farming activities. Farmers want to optimize their farms' benefits. Increasing yield is no longer an absolute objective of their farming activities. Farmers weigh the benefits against costs of their farming activities and decide the best for themselves. Farmers actively seek innovations through research and reviewing old practices. Farmers become experts. Collegial sharing of information and learning by following examples from other farmers who are doing the IPM approach in their farming activities spread the IPM ideas horizontally. Farmers are learning from other farmers. Advanced farmers helped others to learn.

Farmers are encouraged to research and present finding at the IPM farmers organized Farmers' Science seminars that meet quarterly. In these science seminars, farmers present their findings of some process they believe will improve the previous farming practices. One such innovation on rice cropping, for example, direct seeding will speed up harvests time by about fifteen days. For hundreds of years farmers in Java always transplanted rice from the seed-bed to the field until some of them found, that new roots will come out of the rice stem near the soil surface. The old stem buried in the soil after the transplantation will no longer used by the plant; it dies out and decayed. Rice plant growth after these new roots development then become significant through the harvests. Therefore using direct seeding technique, no transplanting is required. Rice seed are planted near the surface and plants grow in the field undisturbed until harvest time. With direct seeding farmers save money for transplanting labor cost and 15 days earlier to maturity.

Table 3 was created to show a comparison between the Green Revolution with Integrated Pest Management (IPM) way. In this table, emphasize on the main differences of both approaches focuses on the following issues:

- The purpose of the programs
- Who's in charge for decision-making?
- The learning process involved
- Ownership and control of agricultural knowledge
- Acceptance amongst farmers
- Costs of agricultural inputs
- Benefits to farmers
- Impacts on Environment
- Final Results: cost against benefits
- Impacts on Personal health and on farm animals
- Degree of Innovations and research findings amongst farmers
- Impact on farmers' political freedom

The above issues are the differentiating factors between the Green Revolution way and the IPM way. There are very few similarities among these two approaches, especially in regards to respecting farmers' own knowledge, farmers' capacity as manager of their farming activities, and farmers' perception of environment and health safety. It was also clear that the Green Revolution was disrespectful to farmer's local/indigenous knowledge. The knowledge that has been in domain for centuries and that has helped farming communities to sustain for generations. The IPM approach started with the introduction of observation technique, strengthened with agro-ecological analysis training to farmers were able to build farmers' confident in developing their critical thinking.

Table3: A Comparative Chart between the Green Revolution way and the IPM way

	The Green Revolution way	The IPM way
Purpose	To optimize the national agricultural production of main food commodities through technology transfer for safeguarding national food security	To optimize farmers' food production through improvement of farmers' capacity to do agro-ecosystem analysis through application of ecological friendly technology and farmers' control on their own agricultural practices.
Who's in charge for decision	Government agencies through their extension agents and pest observers	Farmers and their affiliated groups through consultations; peer advising and group's decision-making.
Learning process	Top-down instructions from government extensions agents who tells farmers what to do in their farming activities	Shared learning, community exchange of knowledge, reinventing of communal indigenous knowledge

Continued in the next page

Table 3 continued

	The Green Revolution way	The IPM way
Ownership of Agricultural Knowledge	Farmers became the tools of government food production efforts and therefore have no share in the knowledge system used and applied in their agricultural practices. Farmers were completely alienated from knowledge ownership as such, a constant incentive, monitoring, and instruction needed to ensure farmers will do as instructed	Farmers own and acquire their knowledge through shared learning, individual and communal research, collecting and reinventing communal indigenous knowledge Farmers are in charge in selecting and applying their agricultural knowledge in response to their very own specific farming conditions.
Acceptance amongst farmers	Farmers hesitated to change as and adapt in the green revolution techniques, but credit incentives and threat of being accused as rebellious or affiliated to the banned communist party made people find it difficult to resist and reject the green revolution and not to adapt it.	Farmers embrace the new concepts of IPM and are happy to receive control of their farming activities which was introduced to them using democratic way training. The filed-school concept which becomes the IPM trades-mark later made farmers willing and eager to learn the new techniques.
Costs of agricultural inputs	Very high, normally beyond farmers' capability to afford, but government offers subsidy through their credits scheme It is assumed that harvest will be multiplied significantly and farmers will be able to pay back their loans	Very low, as farmers do not apply manufactured chemicals pesticides and use less and less inorganic fertilizers Farmers assume nothing, and have no loans to pay back or to worry about. Their harvests are for them to keep.
Benefits to farmers	There were cases where farmers made significant yield increase, but there are significant cost and many hidden personal (health) and social costs that farmers have to pay	There are reports that IPM farmers collect a similar yield but with much less costs of inputs and no personal or social costs they have to deal with. Prices of IPM products are gaining better sales at higher prices as these products are considered as organic and healthy products.
Financial impacts: cost against benefits	High input costs, high yields. This does not necessarily bring significant benefits to farmers. In fact, with many hidden costs (personal, health, social costs) the benefits to farmers is marginal if not negative	Lows input costs, significant yields, low cost and affordable technology, minimum health and environmental impacts, plus a higher market price for organic products brings significant benefits to the farmers and their families.

Continued in the next page

Table 3 continued

	The Green Revolution way	The IPM way
Degree of Innovations and research findings amongst farmers	Farmer's innovations can never occur and basically discouraged. The government top-down instruction on what to do and what should be done completely kills any possibilities for farmers to explore other possibilities or try anything different or new in their agricultural practices.	The IPM approach puts the control back to the farmers by training them to observe and analyze their day to day farming activities which make the farmer his own boss in his own land. IPM encourages many alternative solutions for farmers to pick and choose the best for their own; this leads to more exploration of knowledge which many already own. More and more farmers explore new findings through their own research and document their findings to be shared with other farmers.
Impacts on personal health and on farm animals	Significant cases of pesticides poisoning have been reported in various area where farmers apply pesticides. Symptoms ranging from nausea, skin rashes, losing eye sight, to paralysis of muscles are common. Cattle and farm animals, fed with farm residues, suffer significant poisoning symptom that sometimes cause death to the cattle and farm animals.	Farmers do not need to experience or deal with issues or symptoms of pesticides poisoning, either for themselves and their families or for their cattle and other farm animals.
Impacts on the Environment	Excessive application of pesticides and inorganic fertilizers creates significant impacts on environmental degradation. Pesticides kill a wide range of small farm animals (chicken and ducks), poison fish and various wild animals, contaminated drinking water supplies. Uses of inorganic fertilizers hardened the soil. This soil condition did not support the growth of beneficial microorganism and allowed the soil to breath, so it deteriorated cultivated soil. Phosphors (P_2O_5) as one of the main inorganic fertilizer components polluted the water by tying in the Oxygen. This lower BOD level in water that made water becomes hard to breath for aquatic animals.	Uses of manufactured pesticides and inorganic fertilizers are drastically reduced or completely non existent as such it created an environmentally friendly living condition. Through IPM practices farmers rethought their farming practices readjusted accordingly to meet their agro-ecological awareness.

Continued in the next page

Table 3 continued

	The Green Revolution way	The IPM way
Impacts on farmers' political freedom	Farmers are politically curtailed, any efforts for organizing farmers will be crushed and accused of anti-development, non patriotic and associated with the condemned and banned communist's movement Farmers are politically curtailed, any efforts for organizing farmers will be crushed and accused of anti-development, non patriotic and associated with the condemned and banned communist's movement Farmers were afraid to speak up.	Along with the democratization following the change of government, farmers enjoy a high degree of political freedom. The IPM agriculture plays a significant role in educating and encouraging farmers' higher level of political awareness. It is more common to see farmers exercising their political and group bargaining power. The formation of National Association of IPM farmers in Yogyakarta July 1999 is an indicator of how farmers and farmer groups in Indonesia are enjoying their political freedom and exercising their political power. Farmers reclaimed their freedom and become politically liberated. They were not afraid to speak up.

The Switch to IPM

The switch from the Green Revolution national program to Integrated Pest Management (IPM) happened as IPM farmers learn to be critical and innovative about their farming practices. Farmers identify their farming problems and apply solutions to these problems either personally or in group through sharing of ideas and experiences, something that never happened during the Green Revolution era, and was even discouraged. The critical attitude of the farmers comes about from the analytical skills developed from the IPM training through the Field schools approach. The IPM techniques require farmers' capability to analyze and be creative in finding and applying solutions to their very own piece of rice field. Although the focus of IPM is in controlling the pest, however the whole approach is comprehensive. Farmers need to be knowledgeable about their crops, soil and water condition, climatic situation, temperature and sunlight intensity, and so on. All these conditions will factor in to their agro-ecological analyses and determine their crop situation and decide whether they need to take actions or leave the crop alone, if they are in good and healthy condition.

IPM brings many changes to Indonesian agricultural life. The four decades of the Green Revolution poisoning the environment, the people, and animals in most farming communities is now practically over. But the Green Revolution is still hanging on in the Indonesian agricultural system, although with no subsidies from the government, it has become an insignificant program and will eventually phase out of Indonesia. The supporters of the Green Revolution are the pesticides and inorganic fertilizers companies, which, during the Green Revolution era enjoyed sky-rocketing profits. These companies even tried to introduce another version of IPM with pesticides application. These efforts made obvious how desperate these companies are to win back their former customers, the farmers.

IPM began farmers' research and experimentation. Though these researches were simple and field-problem oriented, they did not lack the rigor applied to many researches done by scientists in their laboratories. For farmers, doing a sloppy research job may cause the failure of harvests. And this could mean starvation for their family. Farmers are cautious about their researches and aware of the risks involved in.

Farmers, who became IPM farmers, pursue their innovation and research finding to many agricultural practices for their own improvements. Many are experimenting with a local brew of natural pesticides, the use of bitter leaves and beetle nut for controlling golden snails which are damaging the new rice seedlings. Farmers use fungi such as *Beuvaria bassiana* to control BPH and rice seeds bugs (RSB). Farmers revisited many indigenous practices and found them useful in their agricultural activities, for example the knowledge that marigold repels insects; the smell of dead fresh water crab attracts rice ear bugs from the rice crop so farmers can trap them and kill them by burning.

IPM farmers made even further advancement in pursuing techniques for making organic fertilizers. Green manure and animal manure are one of the common fertilizers which have been used for generations. Farmers explore composting techniques using harvest residue with a number of variations using kitchen ash, lime powder and zeolites. These experiments by individual farmers were tested and documented and later shared in the farmers' technical meeting, a forum created by the IPM program to encourage farmer's science and research. Liquid green fertilizers are made out of legumes leaves, such as *Lamtoro gung* or *Leucaena Leucochepala*, English name wild tamarind or lead tree and *Gliricidia Sepium*, English name Madre de cacao or Mexican lilacs. Farmers fortified the dose and improved its retention level of these green fertilizers with various mixes of lime powder and malt residues.

The later IPM activities in Java focused on going organic. Farmers will likely progress to omitting all inorganic components of their farming practices, such as the use of inorganic fertilizer, and be one step closer to becoming completely organic farmers. The growing health-conscious market in Indonesia is responding to this trend by a willingness to pay a higher price for organic products. This in return provides incentives to farmers to produce natural/organic food supplies to Indonesian markets.

The IPM experience of rice farmers in Java is a success story in Indonesia agricultural communities. It brings a revolutionary change in Indonesian farming practices, spreading all over Indonesian islands and provinces. It even spreads to Indonesia's neighboring countries. It saves the environment, conserves biodiversity, raises more food, and ensures higher profits for farmers. IPM message to the government concerned with issues of national food security: Feed the farmers first and they will feed the nation. Farmers should be free to observe, analyze, and think for themselves. This way we can guarantee they will make the smartest decision about what is good for them and their families, the country and the environment.

Following the success of IPM in Java, FAO created the Inter-Country IPM Program whose main purpose is to spread this Indonesia experience to all of its neighbors. With this success story, the Food and Agricultural Organization of the United Nation decided to expand the program to many neighboring countries such as Vietnam, Cambodia, China, Bangladesh, Thailand, Philippines, Malaysia, Laos, including Egypt and some African nations. The Indonesia National IPM Program further applies similar techniques on other food crops and secondary crops.

IPM success stories lead farmers to move away from the Green Revolution and significantly reduced of sales of manufactured pesticides and inorganic fertilizers. These major corporations reinvented themselves into biotechnology companies producing genetically modified crops the second phase of the Green Revolution. The following chapter will discuss these corporate initiatives that stirred so many controversial reactions among agricultural communities and businesses around the world. For this part I use most examples from the USA and Canada.

CHAPTER 5

GREEN REVOLUTION PHASE II: GENETICALLY MODIFIED ORGANISMS (GMO) AND BIOTECHNOLOGY IN AGRICULTURE

The increase in agro-ecological awareness among farmers and consumers around the world that resulted from the introduction of programs such as IPM was a tremendous blow to corporate farming. The Green Revolution Phase II is the corporate effort to revive their industry. Without regards for social and environmental costs, large biotechnological corporations are launching new products known as genetically modified organism (GMO) crops for the simple purpose of maximizing profits and minimizing costs. During the past decade, using genetic modification technology, these companies have been able to manipulate inter-kingdom hybrids. Using this technology, these corporations have been able to create creatures never before found in nature. In 1995, biotech companies were able to make genetic insertion of Bacillus thuringiensis (Bt) into corn plants creates a variety of corn containing a built in Bt toxin that kills European corn borers (ECB) that eat any part of the corn plant. This corn injected with Bt also kills any attacking larvae and insects that eat the plant.

The purpose of the Green Revolution practices is obvious: to optimize food production at all costs. This purpose has become the guiding principle of the program around the world. Lured with the concepts of national food security, lucrative governmental funding, and loan facilities made available by developed nations, most poor countries bought into the program and implemented it with iron-fisted, oppressive, and top-down approaches. These countries' governments acted blindly in implementing the Green Revolution, disregarding the complaints and sufferings of their own people, especially the farming communities.

The Green Revolution was launched without fulfilling any requirements for impact-analyses studies. It was hurriedly adopted by governments who used the concept of feeding their people and saving the world from hunger as power to prevent revolts and pacify their people. Since its inception in the 60's, many impact-analysis reports published in various IPM studies concluded that the Green Revolution produced detrimental effects to the environment and human health. These reports created controversies and significant degree of resistance from around the world.

The Green Revolution turned biotech companies responded with Green Revolution II by using genetics engineering to upgrade their innovations. GMO or transgenic crops are the new platform offered by agricultural corporate giants like Monsanto, Novartis, AgrEvo, DuPont, and other smaller chemical companies that reinvented themselves as biotechnology companies. Teaming up with the World Bank, IMF, and other international agencies, these companies redirected the world's anti-hunger focus towards a path of using more agrochemicals such as inorganic fertilizers, herbicides, and pesticides, as well as genetically modified crops. This second Green Revolution, they told us, would save the world from hunger if we allow these companies, motivated by the free market, to do their magic (Rosset et. al., 2000). In other words, it is laissez faire.

Benefits and Detriments of Bt

GMO plants have been genetically engineered to produce a certain quality of crops. The most common engineered gene characteristics injected into cereals and cottons are *Bt* (*Bacillus thuringiensis*) and herbicide tolerant (HT)[5]. Bt strain gives plants built-in insecticides. HT the herbicides systemic that exists in those crops.

In nature, *Bacillus thuringiensis* is an organism well known and commonly used by many organic and sustainable growers as a valuable tool for pest control. Bt is known for its capability to produce Bt toxin that kills various pests, especially effective in controlling its larvae form. Bt toxin causes fatal coagulation in the digestive systems of insects and larvae. GMO crops can have this protection built-in by genetically altering the DNa to include Bt by splicing the toxin gene strain into the crop with protection against insects. This new gene enables the transgenic crop to produce insecticidal toxin throughout the plant's systemic body (i.e. leaves, stems, roots, flowers, pollens, etc.).

The GMO or biotech companies claim that none of the toxin gets into the seeds. This means, it should be safe to consume the grain. This controversial statement is heavily contested by consumer groups from around the world. European Union bans all the Bt GMO products from entering the food system, which includes a ban on Bt products entering the animal food chain. The United

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[5] Herbicide tolerant or herbicide ready GMO crop will have only one specific herbicide of immunity. This carries that specific company brand of production. For example, Monsanto released RoundUp-Ready ™ corn seeds. This corn seeds will have the resistance of glyphosate; the active ingredient of RoundUP™. RoundUp-Ready ™ corn will not resist *bromoxynil*, another herbicide's active ingredient made by Rhone-Poulenc. In other words, RoundUp-Ready ™ corn will die if sprayed with Rhone-Poulenc's *bromoxynil*.

States also ban Bt GMO products for human food, but allows Bt grains for animal consumption.

External application of Bt does not greatly impact crops or the environments, but its GMO Bt crops version brings questions to its impact on human health and the environment. Though producers of Bt crops claim there is no trace of Bt toxin in the seeds or grains produced by GMO Bt crops, on the contrary, a number of known unwanted effects have been found to interfere with nature and ecological balance. In 1999, a note appears in *Nature* magazine claiming that transgenic corn pollen harms Monarch caterpillars (*Danau Plexippus*) reported by Losey et. al. as follows:

- Bt corn pollen is toxic to the monarch butterfly in its larval stage. In laboratory tests, Cornell University entomologists have shown that pollen from Bt corn kills monarch caterpillars.
- Nearly one-half of the Monarch caterpillars that ate milkweed (*Asclepias Syriaca*) leaves dusted with Bt corn pollen died after 4 days—compared with no deaths among caterpillars that ate leaves with normal corn pollen or no pollen at all.
- Bt-corn pollen also altered the eating behavior of the caterpillars that survived –they consumed far less pollen– after four days they had eaten about one-half as much as caterpillars on leaves with normal pollen; as a result, they grew much more slowly. (Losey, 1999)

If the laboratory results reported in the May 20, 1999 *Nature* magazine article extend to the field, then monarch caterpillars, and perhaps many other moth and butterfly caterpillars, including endangered ones, which eat near Bt-corn fields, are at risk. The US Endangered Species List names nineteen species of endangered or threatened butterflies and moths. Pringle noted in his article, *Caught in a Flap*, published in Australian Financial Review, that the use of Bt varieties had expanded dramatically since it was first planted in 1996. They had become the industry's banker at a time, in the late 1990s, when opposition to other products was gathering force, especially in Europe. Short of some human health hazard, it was hard to think of a bigger propaganda setback than monarchs being killed by Bt corn (Pringle, 2001).

In 1998, Swiss scientists reported laboratory results showing detrimental effects of Bt corn on green lacewings, beneficial insects that feed on pests, including the European corn borer or *Ostrinia nubilalis*. Lacewings (*Neurophtera Sp.*) fed ECB that had eaten Bt corn had a higher death rate and delayed development compared with lacewings fed ECB that had eaten non-Bt corn.

Research from New York University indicates that active Bt toxins genetically engineered into Bt crops, including corn, may accumulate in soil, kill sensitive soil-inhabiting insects, and place soil ecosystems at risk. Scientists expect Bt corn and other Bt crops to accelerate the evolution of resistance to Bt toxins in insect pests. When this occurs, organic growers and others who rely on Bt sprays will lose an effective, natural bio-control agent.

John Obrycki and Laura Jesse, from Iowa State University, had similar research findings. They attempted to recreate field conditions in a three-year study. After putting potted milkweed plants in cornfields during the corn's pollen shed, they took the plants back to the lab where larvae were fed the leaves. They found that some larvae died. They reported their results to colleagues and the biotech industry before publication of Losey's at Nature magazine paper. Their work was not published for another year by which time it generated more alarm. They would claim to have the first evidence that transgenic Bt corn naturally deposited on milkweed in a cornfield causes significant mortality (Pringle, 2001). Pringle further reported that the biotech industry complained that the Iowa work was not a realistic field test either because of the potted milkweed plant experiment did not represent the real situation monarch larvae encounter in the real world situation. Some researchers agreed.

Not long after the report in Nature magazine, major U.S. print and broadcast media outlets picked up on the note without considering the caution. The media presented the idea that monarchs were being killed by pollen from Bt corn planted by farmers. According to USDA this misimpression fueled a public outcry. The European Commission reacted by placing a freeze on the approval process for Bt corn and activists in the United States called for a moratorium on the further planting of Bt corn (USDA, 2002).

The following year, Agricultural Research Service and the industry group, Agricultural Biotechnology Stewardship Technical Committee, provided more than $200,000 in grant funding. Environment Canada, with the approval of the

Canadian Food Inspection Agency, provided funding for similar research in Ontario. Projects were selected and funded through a grant process, overseen by a steering committee with diverse interests, including those with concerns about the application of biotechnology to agriculture (USDA, 2002).

Studies on Bt corn and monarchs published in September 2001, *Proceedings of the National Academy of Sciences* (PNAS), described the benefits of Bt corn and cotton. These new studies published in September in PNAS found that pollen from the best-selling Bt-corn varieties poses negligible short-term risks for monarchs. They did not, however, completely resolve Bt corn's impacts on the insect. These experiments follow up a 1999 Cornell University laboratory study, which demonstrated that Bt-corn pollen could be fatal to monarch butterflies (National Academy of Sciences, 2001).

The Union of Concerned Scientist in their web page (*http://www.ucsusa.org/*) issued the following statement: The new reports showed that pollen from the two types of Bt corn, which account for most of the Bt-corn acreage (Mon 810 and Bt 11), produces relatively low amounts of toxin. As a result, these two types of Bt corn pose negligible short-term risk to monarchs.

But two issues remain: the role of anthers and long-term risks. Monarchs may consume tissue from anthers -- the pollen-producing parts of the corn flower -- as well as pollen from Bt corn. Since anthers have been shown to contain considerably more toxin than pollen, the PNAS studies based on pollen alone may seriously underestimate the toxin dose consumed by monarch larvae in corn fields. Indeed, the studies acknowledge the possibility that larvae may consume anthers as well as pollen.

The DNA in Roundup Ready™ is modified to resist glyphosate. Glyphosate is the active ingredient of Roundup, the major herbicide product made by Monsanto. Monsanto claim Roundup Ready™ soybeans are associated with the move away from popular herbicides like atrazine, whose active ingredients persist in the environment. The Union of Concerned Scientists reported, however, that Glyphosate is highly toxic to plants and fish. Those who care about the environment would not welcome the annual dousing of 12 million acres of American farmland with such a chemical. In addition, many preparations of glyphosate are dissolved in so-called inert ingredients that can also be toxic. It is highly unlikely that chemical companies that produce herbicide-tolerant plants will ever develop products that cut into their substantial herbicide revenues. Thus, to the extent that Roundup Ready™ products are environmentally beneficial, this is likely to be the limit of progress in that direction. Ultimately, U.S. agriculture remains shackled to intensive chemical use.

Moreover, the Union claims that the use of glyphosate-tolerant soybeans pose an environmental risk. These herbicide-tolerant crops can transfer their tolerance trait to nearby plants and weeds genetically related to the crop. While there are no such relatives in the United States, they do exist in other parts of the world. In the United States, the use of glyphosate on millions of acres will intensify the selection pressure for resistance in weeds unrelated to soybeans. As weeds become resistant, farmers will have to use more glyphosate, accelerating the downward spiral toward the loss of glyphosate as a weed-control tool. In addition, the glyphosate-tolerant plants could have effects on soil ecology that have not been assessed.

The question is, are there alternative approaches to weed control other than intensive, prophylactic herbicide use? Yes, there are new tillage methods, multiyear crop rotations, cover crops, and other techniques of bio-intensive weed management. Scientists also urge farmers to accept of levels of weeds that may give their fields a messy appearance but have no economic impacts (Union of Concerned Scientists, 2003).

The voices of concerned farmers are equally loud in rejecting this genetic engineering path of plant breeding as unwanted. This Australian based association of concern farmers wrote in their online page:

> "Genetic modification" only refers to the recombinant DNA plant breeding technique. This is where genes are transferred from one organism to another and the most common application is with cross kingdom breeding. For example, bacteria and virus genes are used in GM canola to produce chemical resistance. The GM problems occur because consumers reject this type of plant breeding technique (Newman, 2003).

The Network of Concerned Farmers and industry stakeholders insist on halting any commercial release until protective legislation is in place to ensure the GM industry is responsible for containment[6] of their products and all associated costs and liabilities. We must assess economics, protect existing agricultural systems, and ensure industry preparedness. The following are the conditions demanded by the Network of Concerned Farmers:

1. **Assessment of Economic impact:** Conduct an independent and widely consultative, transparent assessment is undertaken to determine the economic impact of the proposed commercial release of GM crops. If an unacceptable or unmanageable economic risk is identified, commercial release must not proceed until issues are resolved.
2. **Protection of existing systems:** Guarantees through appropriate legislation that GM crops will not be released until a legislated and regulated system is implemented that guarantees protection of organic and conventional farmers who choose not to grow GM crops. This must enable farmers the right to continue to farm unrestrictedly non-GM, GM-free or organic and market their crops as uncontaminated non-GM, GM-free or organic as per market specifications including to a "nil detectable" status according to testing industry technology available.
3. **Industry preparedness:** Each segment of industry must identify GM related problems and indicate preparedness and a suitable management plan prior to consideration for commercial release. This democratic right must involve the majority of stakeholders within each industry segment. No sector of industry should be faced with unmanageable problems (Newman, 2004).

GMO Impacts on the Environment

In the paper presented by Margaret Mellon at a conference with the title: *Genetically Modified Foods – the Recent Experience*, in Copenhagen, Denmark, June 12-13, 2003, she stated that genetically modified crops on the market in the United States are:

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[6] This means GM crops planted nearby NON-GM crops should contain their GM pollen from contaminating their NON-GM neighbors.

So far, more than 40 genetically modified crops are currently allowed in commerce in the United States. Two traits – herbicide tolerance (HT) and insect resistance (Bt) engineered into four commodity crops (corn, cotton, soybeans, and canola) – dominate the products that have succeeded on the marketplace. Monsanto's products are the most popular of these crops but three other companies – DuPont/Pioneer, Syngenta, and Dow/Mycogen – also market them.

Two virus-resistant crops, papaya and squash, are currently planted on small acreage (fewer than 7,000 acres) in the United States. In addition, many of the products allowed on the market are not, as far as we know, actually being sold in commerce, including: the first commercial genetically modified food crop, the FlavrSavr tomato; other engineered tomatoes; altered-oil canola; several Bt crops (Bt potato and four Bt-corn products); HT sugar beet; and male-sterile chicory (Mellon, 2003).

Described in the pages above is a new front of issues in regard to revolutionizing the world food production. This revolution uses a new platform in launching its new initiatives namely genetic engineering; through modifying a certain plant characteristic which using cross species DNA alterations. Since the launching of the first GM product in 1994, there are controversies regarding the issues causing massive red flags to the environmentalists and many concerned farmers' coalitions (Mellon, 2003).

Bt crops controversies on one side the biotechnology companies claim that Bt crops reduce the application of pesticides by the growers. Research suggests this claim is unfounded, as Bt corn has had little impact on overall corn insecticide use because growers typically have not used insecticides to control corn borers. Between 1991 and 2001, farmers consistently applied insecticides to approximately 33% of US corn acres (Mellon, 2003).

On the other side, it creates unnecessary impacts to non-target population.

- Pollen of Bt corn are suspected to be toxic to Monarch butterflies larvae feeding on milkweed leaves that grows around the cornfield. If the pollen of Bt corn were indeed toxic to butterfly larvae under field conditions, the widespread planting of Bt corn could threaten an estimated 50% of the butterfly population.
- It kills adult Lacewing feeding on the European corn borer (ECB). Lacewing is considered a beneficial insect by organic growers, as it preys on ECB larvae.
- Bt crops might create organism that will resist Bt. If this happens, many organic growers will not be able to use Bt for external natural pesticides effectively.
- Roots of Bt crops are toxics to the surrounding soil and kills many good organisms around their root-system (Mellon, 2003).

Controversies around herbicide tolerant (HT) crops show that over since the first HT crops were available in the market; there are more occurrences of weeds that resist glyphosate, the active ingredients of Monsanto's Roundup® herbicide.

> A few years ago, only one weed—ryegrass in Australia—was known to be resistant to glyphosate. In the last three growing seasons, however, weeds resistant to the herbicide have been reported in six states in the United State. Glyphosate-resistant horseweed, or mare's tail (*Conyza canadensis*), emerged in 2000 in

> Delaware in soybeans, in 2001 in Tennessee in cotton and soybeans, and in 2002 in Indiana, Maryland, New Jersey, and Ohio, also in soybeans.
>
> Even in areas where resistant weeds have not been reported, scientists are seeing shifts in dominant weed species that may be due to heavy use of glyphosate in engineered crops. For example, University of Illinois specialists suggest that increases in eastern black nightshade in Illinois soybean fields may be a result of widespread adoption of the glyphosate-resistant crop and the concomitant use of the herbicide in the state. Similarly, weed scientists in Iowa are finding populations of water hemp that survive spraying in fields of glyphosate-resistant soybean (Mellon, 2003).

At the Genetically Modified Food Conference in Copenhagen, Margaret Mellon pointed out that HT will be short lived due to increasing numbers and varieties of weed capable to resist glyphosate:

> Already there are signs that the most popular HT crops—those resistant to the herbicide glyphosate (Roundup®)—will lose effectiveness as weeds become resistant to the herbicide. Scientists expect that Bt crops, too, will succumb to pests that evolve resistance to the Bt toxins. Concerns have also been raised recently about the possible evolution of a virus strain resistant to another genetically modified food crop—papaya engineered to withstand the papaya ringspot virus.
>
> Just as overuse of antibiotics led to antibiotic-resistant diseases in people and animals, overuse of pesticides on U.S. farms has meant that chemical after chemical has become useless as pests develop resistance. HT and Bt crops will likely suffer the same fate because they, too, are overused (Mellon, 2003).

Conclusions

The abundance in food due to increased production does not eliminate the problems of hunger. We have seen that increased food production has done nothing to eliminate hunger. Hunger alleviation relates more to the social-justice fabrics of a country. Abundance of food alone does not imply fair food distribution. It is common to see hunger walking hand in hand with abundant food production. The true hunger alleviation efforts should be done through empowerment of the poor, the hungry farmers, so they can produce more and better quality of food. Records show that over four decades of the Green Revolution, massive landmass switched ownership from poor farmers to the richer farmers. This problem alone becomes the major cause of dislocation of people from the rural and food production areas in to the cities slums where they live as beggars and suffers hunger all their lives.

Farmers cannot trust corporation selling more technologies to boost agriculture production, conventional or biotechnological. These corporate manufactured technologies are artificial and work against nature. Nature fights by developing resistance to the pesticides, herbicides, and gene manipulation. These companies have created creatures whose interactions with the environment are not yet fully understood. Over time, these pesticides and herbicides will lose their effectiveness toward their target population and will require more chemicals. This is another recipe for clinging on to dependencies to those corporations.

Agriculture concepts based on understandings of agro-ecological principals of nature should be the focus of farmers. Reinvention and revival of uncounted agricultural indigenous knowledge which was lost from various indigenous communities are crucial to support agricultural sustainability efforts. IPM and other organic and agro-ecological approaches (OAA) should take the lead in the struggle to feed the nations and eventually the world. Farmers should not look for immediate profits and gains gimmicked by the chemicals turned biotechnology companies. These companies have broken promises and will do it again and again.

CHAPTER 6

FARMER FIELD SCHOOL: THE GATE TO IPM AGRICULTURE

Introduction

This chapter describes the process of the IPM Farmer Filed School (FFS/IPM). It describes its philosophy, its activities and the most important role it plays in bringing in hundreds of thousand of Indonesian farmers into the IPM learning experiences. The FFS/IPM was instrumental in educating farmers to fully understand the practices they apply in the food crops they grow and the consequences of their action.

Farmers Field School – An Innovative Educational Process

The FFS/IPM had shown that it was an educational process that proved to be the engine for changes in agriculture practices. FFS/IPM served farmers by opening their eyes to the tremendous values and benefits would otherwise be missed without the FFS/IPM. The Farmer Field School became the major instrument for the success of IPM program in Indonesia and in many other countries around the world. These countries are Vietnam, India, Bangladesh, The Philippines, China, Korea, and Sri Lanka. The successful FFS/IPM model developed in Indonesia became a model for the above-mentioned countries, and they too were able to achieve great success using the Indonesian model.

Farmers Field School – An Eye Opener and the Gate to the IPM

All these benefits enjoyed by the farmers started with a process of learning. That process led them to the conviction that it was the IPM farming system that restored to the farmers their ownership of their own knowledge.

The gateway for farmers' to this entrance of claiming ownership of their knowledge lies in the IPM Farmers Field School (FFS). Through the FFS learning experience the farmer encounters an eye-opening experience. FFS is the core of IPM training; it is a non-formal educational (NFE) system that helps farmers learn through their experiences, reflections on their activities, small group discussions, role playing, games, and simulations. This process-oriented method of education emphasizes that the format of learning is as important as its contents and is specifically designed for adult audiences. Adults as learners come to the classroom, or a meeting place, with their life-rich experience to share with others. This process of sharing enhances the group knowledge where each individual learns and improves each other's personal knowledge.

This NFE group process helps the individual to learn. Russell D. Dilts was the Director of the IPM National Program, and then later became the Director of the Inter-country IPM Program. Together with John Pontius: he wrote "An Introduction to the IPM Farmer Field School", in which he made the following statement:

> The IPM Farmers Field School (FFS) is the primary learning approach used within the context of the Indonesian National IPM Program. The rice IPM Field School is a season-long learning experience. In the Field School, farmers learn about the rice field as a field laboratory. In the laboratory, FFS participants learn about the ecology of the rice field by agro-ecosystem management. The Field

School makes use of farmers' rice-field as field laboratory. In the laboratory, FFS participants learn about the ecology of the rice filed by means of regular observation and hypothesis testing. (Dilts and Pontius, Manuscript/Report, Jakarta, no date)

Dilts and Pontius thus noted how the FFS learning approach was used in the introduction of Indonesian National IPM program. Early IPM farmers – those who learned about IPM when the program was initially introduced – had learned IPM skills and knowledge only through the IPM/FFS training. But after, the program had run a few years there were farmers who had learned IPM skills and knowledge through collegial learning, i.e., learning through their fellow farmers who had already acquired their IPM skills and knowledge from initial training. The three advanced IPM farmers I chose for my in depth study were among the first generation who had received an early IPM training.

Dilts and Pontius further explained the Farmers Field School approach in the following statement:

> The learning approach in the Field School employs a participatory learning method. The process emphasizes the taking of decisions and actions based on an open discussion of ideas which is free from the domination of any individual. These decisions form the basis for the hypotheses which are tested in the field laboratory. The Field School process, besides its emphasis on field ecology, provides participants with an opportunity to examine human social dynamics. As a result, FFS participants not only learn about the cause and effect relationships which exist in the rice field; they also acquire a greater understanding of human relations. (Dilts and Pontius, Manuscript/Report, Jakarta, no date)

The IPM training provided the support that farmers needed to bolster their coverage in exercising the new freedom to make decisions about their farming activities, a freedom that the BIMAS program did not allow. IPM training encouraged farmers to make smart decisions about their farming plans and activities. In the FFS farmers learned to be proactive in pursuing knowledge. As Dilts and Pontius wrote:

> The analytical processes employed in the FFS enhance farmers' capacities to examine the conditions in which they live and work. Participants, having completed their FFS, are able to take decisions on actions which would improve those conditions. The increased understanding of participants regarding human social dynamics enables them to develop collaborative efforts that ensure that planned actions are implemented. (Dilts and Pontius, Manuscript/Report, Jakarta, no date)

Origins of the Farmer Field Schools

Douglas Dilts and Simon Hate (pronounced Hah-Teh), two IPM/FAO program leaders, wrote an account of how the FFS began. The term "IPM Farmer Field School" or Sekolah Lapangan Petani untuk Pengendalian Hama Terpadu (SLPHT) was seldom heard in the first years after the inception in 1986 of the IPM. The contrast four years later in the early 1990's is striking:

> The phrase 'Farmer Field School' began to be heard in Indonesia in 1990. For most, this was a strange, if not alien, juxtaposition of the disorderliness of the paddy field mud with the orthodox orderliness of the classroom. Five years later IPM Farmer Field Schools have been conducted in more than 15,000 villages in Indonesia, and in thousands in Vietnam, India, Bangladesh, The Philippines, China, Korea and Sri Lanka. In Indonesia the sight of these "schools without walls", involving farmers gathering together on a weekly basis throughout a crop season to go into the mud to analyze the progress of their crops; learn of the biotic interactions between soil, plants, and insects; and bring this knowledge together to make a locally responsive field management decision, is no longer strange. (Dilts and Hate, Jakarta, no date)

What is an IPM Farmer Field School?

FFS/IPM is a unique non-formal system of education. It is not a common school with class rooms and fixed curricula. Many IPM publications expressed it as resembling a “school without walls”. Participating farmers generated the learning materials; they created their learning tools, they ran the field laboratories. There are only two traces of commonly known instructional systems: (1) FFS/IPM runs pre and post tests to show individual achievements made during the school period and (2) the graduates receive certificates of completion. The farmers and other participants in the democratically run FFS/IPM determined the school curricula. The Farmers' Field School differs substantially from conventional extension activities in that it has:

- A season-long, crop-linked schedule and curriculum stressing experimentation, analysis, and decision making by farmers themselves.
- Farmer-generated materials and learning tools including field trials, insect zoos, insect collections, and agro-ecosystem analysis charts.
- A 'field lab' or ‘learning field' as the heart of the field School consisting of a 1000 meters square plot run by participating farmers comprising comparison trials and field experiments.
- Entrance and exit ballot box' tests to gauge participant progress, plus 'IPM Certificates' for successful graduates.
- Full-time, thoroughly trained IPM facilitators who work with the Field School from preparation through graduation.
- Follow-up activities including 'Field Days' for the community, 'horizontal communications' activities, training of Farmer Trainers, Farmer Studies, and a variety of organization building activities. (The Indonesian IPM Program, Report, Jakarta, no date)

A Day in FFS/IPM Training

FFS/IPM training conducted for one cropping season, which is about 12 – 13 weeks, and meets once a week. A day of FFS/IPM training starts at 7:30 AM and ends at early afternoon around 2:00 PM. A typical day in activities in FFS/IPM training runs like this:

7:30 **Into the Field:** Five-member teams observe general field conditions, sample plants, collect insects, make notes, and gather live specimens from Field School plots. The field provides all of the basic learning materials and subject matter for the Field School.

8:30 **Agro-ecosystem Analysis:** This is the core of the weekly process. Each team uses their field samples and notes to create a visual analytical tool combining key factors such as pest/predator densities, plant health, field conditions, weather, and current management treatments.

9:30 **Decision making:** The output of analysis is a field management decision thoroughly discussed in small groups and defended in open discussion before the full group of participants. `What if..?' problem-posing further hones analytical skills during the discussion among groups.

10:00 **Special Topics:** These activities are linked to crop stage and to specific local issues. This part of the curriculum is tailored for each Field School from a larger selection of `Field Guide Activities' mastered by facilitators during extensive training. These exercises require more field work on topics such as community rat control, crop physiology, health and safety, food webs, field ecology, economic analysis, and water/fertilizer management. Supporting studies such as 'insect zoos' for learning; plant-insect and insect-insect interactions; are also initiated as part of 'Special Topics'.

10:30 **Group Dynamics:** Activities in problem solving, communication, leadership, and team building are conducted weekly to strengthen group cohesion, maintain motivation, and help participants develop organizational skills.

12:00 **Review and Planning:** weekly summaries of developments in the field are conducted by reviewing results of the agro-ecosystem analysis. At the end of the season final yield and economic analysis is done by the group. Other long-term activities are reviewed during this session. Such activities may include the development of Insect Zoos for learning about plant-insect and insect-insect interaction, dry insect collections, rat control trials, plant nutrient experiments, and plant compensation studies. The planning of future Field School activities also takes place at this time. (The Indonesian IPM Program, Report, Jakarta, no date)

For farming activities a schedule running from 7:30 AM to 2:00 PM is considered a full day's activities. In the above description of scheduled activities the five major components of the program stand out: (1) field observation, (2) analyses of agro-ecological system of the crop, (3) decision making, (4) exploration of new knowledge, and (5) planning of actions. In all of these activities the training uses the group or shared learning process. The group doesn't learn but individuals in the group thrive in a group learning setting. The use of shared learning process in the group context has been the strength of FFS/IPM training. Participating farmers continued their discussions when the training day was over. Farmers were continuously helping and supporting one another in that group setting.

In 1992 Michael Useem, et. al., made a comparison between conventional training as conducted by BIMAS and the IPM training. They constructed a hypothetical from their field observation, a typical interchange showing with stunning clarity how IPM training might contrast with conventional field training, how IPM training prepared farmers to make informed decisions, and how IPM training encourages farmers to ask questions. Every response made by the IPM trainer will challenge the farmers to search for more answers. The following table compares how the interactions between the farmers and their trainers as they would occur in the two different models:

Table 4: BIMAS/Conventional Training versus FFS/IPM Training

Conventional Training	IPM training
(The trainer lectures on rice field pests, using both Latin and local names, and then accompanies the farmers to the field where they observe insets) *Farmer:* What's this bug? *Trainer:* It's BPH, a serious pest. You must spray your fields with (the preferred pesticide) in accordance with the instructions on the local package so you don't get these pests in your field. *Farmer:* I see	*Trainer:* OK, let's go to the field. Remember, work with your groups of five and collect the bugs along the transect in both the IPM and local-package fields *Farmer:* What's this bug? *Trainer:* Where did you find it? *Farmer:* On a plant over there. *Trainer:* Where on the plant? *Farmer:* On the tip, the underside. *Trainer:* What was it doing?

(Useem, Michael et. al., 1992, p. 457)

Four IPM Basic Principles

IPM built the foundation of its program on four basic principles. These four principles were reiterated throughout the FFS/IPM training and at every opportunity in the course of IPM related events. IPM alumni will always remember these principles and apply them in their farming activities. Here are the IPM four key principles as brought to life via the Field School process:

- **Grow a Healthy Crop:** encompassing varietal selection, seedbed management, plant nutrition and physiology, water and weed management.
- **Optimize Natural Enemies:** recognizing beneficial creatures in the field, learning insect population dynamics, life cycles, and food webs; understanding the effects of pesticides on beneficial populations, promoting survivorship of predators through habitat management, and making local reference collections.

- **Observe Fields weekly:** including recognition of damage symptoms, changes in insect populations, evaluation of plant growth and physiology, relationships between plant stages and insect populations, effects of weather conditions, and water and nutrient management.
- **Farmers as Experts:** agro-ecosystem analysis and decision making based upon information directly observed and collected trains farmers to make sound crop management decisions across the season. Farmers learn to draw sound conclusions from observation of their fields during each stage of the crop. (The Indonesian IPM Program, Report, no date)

In the early 1990's FFS or *Sekolah Lapangan* term became so popular among other government agencies and private sectors that any training involving field activities was named *sekolah lapangan*. So it was then common to see, for example, *Sekolah Lapangan Peternakan* (Farmer Field School of Animal Husbandry) or *Sekolah Lapangan Kehutanan* (Farmer Field School of Forestry/Agro-Forestry). Even the pesticides industry used *Sekolah Lapangan* of IPM in order to promote the opposite purposes of the original IPM. This exploitation of the prestige of the IPM seemed to be a smart move from the pesticides industry as they sought to reclaim the market shares lost since the FFS/IPM was launched in 1986. This deceptive tactic of pesticides industry might win back some of the BIMAS farmers but almost never the IPM trained farmers. In 1986, with the launching of the IPM program, the government of Indonesia also cut about 100 million US dollar subsidies of pesticides products (Useem et. al., 1992). It was a massive blow to the pesticides industry as they had enjoyed this privilege for over two decades. This phenomenon raises the question: "How deep was the effect of FFS/IPM training on the loyalty of the alumni to IPM values and practices?" Dealing with the similar issue, Dilts and Pontius remarked:

There are political pressures on farmers, from the village level to the national level. These pressures, although it is often claimed otherwise, do not always have the farmers' best interests at heart. Farmers need to be able to understand and act within these forces to guarantee that their interests are served.
Farmers, in any society, are at the lowest rung of the food production ladder. The marketing system in any country does not operate in favor of the farmer. Farmers are placed in the position of being price takers. There are strategies which farmers can use to change this situation. Direct marketing, for example, is one strategy which can increase the incomes of farmers. Farmers need to be able to analyze, understand, and maximize their leverage vis-a-vis market factors (Dilts and Pontius, manuscript, Jakarta, no date).

How Do We Know That Farmers Learned in FFS/IPM?

In order to measure levels of knowledge which have been claimed by farmers during the season-long FFS/IPM training sessions, the Indonesian IPM program employed the FFS/IPM school mode to check the changes of the level of knowledge before the training and after the training. The Indonesian IPM Program report concluded:

> Pre-post ballot box field tests indicate solid learning through the Field School, and IPM comparison plots consistently achieve equal or better yields without the use of insecticides. Farmers discover for themselves the profitability of IPM field management. (The Indonesian IPM Program, Report, Jakarta, no date)

The IPM farmers learned that FFS/IPM training expected them to make a deeper change in their farming attitudes. This change was indicated in the following report:

> More importantly, road-based studies indicate that not only do farmers learn, but that they change their behaviors related to pesticide use and field management decision making. As a result farmer field school graduates experience stabilized or increased yields and increased profits. (The Indonesian IPM Program, Report, no date)

Michael Useem et al. conducted another study of "informed decision" as one of the significant outcome of the FFS/IPM training. Informed decision is a significant indicator for measuring change of attitudes. During the BIMAS era, farmers were accustomed to spraying pesticides on a regular basis; and some simply believed, without information, that pesticide applications would protect their rice crops. Informed decision stemming from FFS/IPM training led to lower use of pesticides. Useem et al. reported that,

> As an intended primary program goal, pesticide usage dropped significantly below the reduced level that had already been reached as a result of the end of public subsidy. The decline did not approach the ultimate program target of only one application every several seasons. But applications were reduced by approximately half among farmers who had received IPM training (IPM National Program, 1991 b).

Supporting the above statement with more data collected from the previous reports, Useem et al noted that:

> A sample of 2,013 farmers was surveyed during the spring of 1991 in the five major regions of the country where IPM operations had been established. All farmers were recent graduates of the 60-hour training course in IPM methods, and they were interviewed on their insecticide usage during comparable 4-mouth wet seasons before and after the course (IPM National Program, 1991 b).
>
> The number of insecticide applications per rice field (some farmers operated several fields) dropped significantly in all five program regions; the overall rate was cut by 62 percent. During the pre-training season, farmers had used no insecticides on only 363 of their fields: after the training seasons, 1.309 fields were insecticide-free. A similar shift was evident in the application of all forms of pesticides (insecticides, rodenticides, herbicides and fungicides). Before training, just over 200 fields were without pesticide treatment: after training, the number exceeded 1,000. Examining the individual approach to insecticide use rather than

Field, 10.9 per cent of the farmers used no insecticides before training: but this figure increased to 52.4 percent after training (IPM National Program, 1991b)

The IPM Impact Survey conducted by FAO/IPM in 1993 supported the above study with the following findings:

- A study of over 3,000 field school graduates found that these farmers reduced their use of insecticides by 60% overall, with the mode application frequency falling to zero.
- The study also found that IPM-trained farmers were less likely to engage in prophylactic or "calendar" pesticide applications. The incidence of calendar spraying, in which farmers apply pesticide at pre-determined stages of the crop cycle regardless of conditions in the field, fell by over 50 percent after IPM training. This means that when IPM farmers did use pesticides they reached the decision to spray based on field observations of insect populations.
- The study showed, the number of pesticides that were not made to kill a specific pest targets dropped by more than 60 percent after IPM training. In other words, IPM farmers make more informed decisions, and are therefore less likely to use pesticides or other inputs in a careless manner (Indonesian National IPM Programme, 1993b).

Prophylactic or “calendar” pesticide applications were a common symptom of the problems generated by BIMAS agriculture, most notably the development of mutations among the pests that enable them to resist the continual spraying of poisons. Thus FFS/IPM farmers switch from automatic calendar spraying to integrated pest management base on their own field observations represented so drastic a change that it caused serious political repercussions. As Dilts and Pontius noted (see above, p. 179), farmers now faced serious political pressures at the village and national level to go back to calendar spraying. A newly graduated FFS/IPM farmer needed courage and stamina to stand up for the new values in environmentally safe and healthy food production.

Data Analysis

The 1991 data presented by Useem et al. a 62% drop rate in use of pesticides from among over 2,000 farmers in five major regions of Indonesia where IPM program were implemented. The impact of FFS/IPM training was clearly significant, considering the year 1991 as one of the early years of the program and the trust or confidence factor to IPM program might still quite low. I mentioned the trust factor as one of the factors that might influence farmers' decision in applying pesticides. The trust or confidence factor can be defined as the level of willingness to take risks of the new ventures. For newly graduated FFS/IPM alumni to make a decision that might cost them the season's harvest might be too big a risk although their informed decision would say otherwise. Later in the program farmers learned through follow-on IPM program activities that damage to the crops during the early stage has little or no effect on the harvests.

The longer farmers remained in the IPM program the more they learned from one another, and the higher their confidence level would become to the IPM practices. The in-depth interview data discussed in chapter 7 reflects that farmers who have been long in the program developed a 100% confidence or trust factor in the program. These farmers have completely stopped applying manufactured pesticides to their rice crops. They have further explored alternative methods of pest control using natural ingredients and microorganisms such as planting Marigold to repel a certain insects, using Beuvaria bassiana fungus to control brown plant-hopper (BPH), and reinventing various indigenous agricultural practices to control or repel pests.

Retention of IPM Values among IPM Graduates

Amazingly, there were about 93% IPM trained farmers who remained loyal to their IPM values after FFS/IPM training. This high retention of the IPM values and practices was the results of follow-up IPM activities that provided tremendous supports after graduation from FFS/IPM. Dilts and Pontius reported in around early 1990's[7] that in over 95 % of the 183 IPM Sub-districts for which there is data, alumni have either organized an IPM based organization or they have re-organized their Farmers Group or Water Users Association to serve as a forum for IPM issues. They further mention that IPM farmers are organizing collaborative projects throughout project provinces. Whether the projects focus on pest control, credit for farmers, seedling production, business enterprises, or

[7] I assume that 1990 was the year of the publication of this manuscript, as it said its introduction: "The phrase 'Farmer Field School' began to be heard in Indonesia in 1990". IPM Farmer Field Schools: Changing Paradigms And Scaling-Up By Douglas Dilts And Simon Hate

promoting IPM, IPM alumni have been able to effectively collaborate with government officials and other farmers to enhance their control over the conditions that affect their livelihoods. These farmers are organizing activities with the support of local government. Rather than posing a threat to local government, IPM alumni are recognized by local officials as contributing to the enhancement of village and sub-district economic development. (Dilts and Pontius, report, Jakarta, no date)

Dilts and Hate (pronounced *Hah-Teh*) explained that the high retention level of IPM knowledge and skills could only become possible with arrays of IPM follow-on activities that farmers as IPM alumni could join in. These arrays of follow-up activities strengthened the knowledge about IPM, provided support group for IPM farmers and enhanced the IPM farmers' network.

Dilts and Hate stated that the goal of the Farmer Field School is not just to impart skills to a set of individual farmers. The goal of the program is to develop an organized group of farmer 'experts', which can serve other farmers and the village as a whole. Numerous activities are undertaken to build this support group, including exercises in communication, leadership and collaboration skills. The initial Field School program is seen as a 'primary school' and after this the group is ready to move on to follow-up program in farmer-to-farmer training, farmer field studies or horizontal communication program. (Dilts and Hate, report, Jakarta, no date)

Having visited a number of FFS/IPM, I could sense the dynamic: the excitement of farmers learning the new way of understanding and analyzing their own farming practices. This process became the core of their IPM learning. Quoting Dilts and Hate (pronounced *Hah-Teh*):

> Perhaps, to environmental and democratic activists, such as Mochtar Lubis[8], the most amazing thing is to see the farmers recapturing their rights and their abilities to learn, speak, and make their own decisions - while being able to back-up their positions with scientific evidence which they themselves own and control. To NGO personnel and extensionists, the remarkable pan of this story is not that farmers are capable decision-makers, but that the process of learning is facilitated on a broad scale through the medium of normal government extension workers - 'People's Theatre' conducted in thousands of villages; 'Farmer Research' going on in every province, thousands of 'Farmer Technical Seminars' and 'Farmer Planning Meetings' taking place, in which farmers are the planners and implementors and government personnel are consigned to a listening role. Currently, over half of all IPM Farmer Field Schools are being run by farmer trainers, with no diminution of process quality (Dilts and Hate, report, Jakarta, no date).

Dilts and Hate explained that the Field School approach for IPM was developed in response to two challenges. First, the ecology of tropical rice---which is locally specific---resists generalizations and blanket recommendations. This therefore presented the second challenge to farmers for the need to generate their own scientific processes in their own fields as a basis for crop management decisions for IPM to be effective and sustainable. They further emphasized the FFS approach, which stood up in sharp contrast to the extension approach that had become the standard practice of the BIMAS agricultural system. Farmer Field School approach represents an attempt to get away from

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[8] Mochtar Lubis is a world known Indonesian novelist/activist and Director General of the Press Foundation of Asia.

centralized extension practices and return the focus of interaction to the farmers' fields. It is at heart process that brings people and ecology into direct interaction.

Dilts and Hate (*Hah-Teh*) further described how the FFS/IPM libertarian approach was differed from the standard, conventional extension approach of BIMAS. They described as it as a “paradigm shift”:

> If agricultural extension is defined as the practice of 'extending' packages and information developed from centralized research to farmer 'target groups', the Field School Approach, with its emphasis on decentralized educational processes and *in situ* discovery and learning by farmers, represents a radical departure from established practice. Many have described this departure as a' paradigm shift', because many of the previous articles of faith and basic assumptions of extension have been called into question. In short, the Field School approach for IPM seeks to replace 19th century, top-down, input technologies with 21st century, knowledge-intensive technologies (Dilts and Hate, report, Jakarta, no date)

It became clear that FFS/IPM employed a democratic approach in all its training. It pushed aside the top-down conventional approach that devalued farmers as the owner and the origin of the knowledge. All the farmers who graduated from the FFS/IPM, graduated with pride and with a high spirit of sharing the knowledge they had collectively learned.

In Farmers' Own Words

The comment of one farmer explaining his actions are illustrative of the altered management attitude. Rusdi Aminulah, a farmer and IPM trainer reported:

> Before I participated in a Field School I only new that I had plants, there were pests in those plants, and pesticides were weapon to control pests. Hey, I would spray pesticides even if there were not

> any pest just to be safe. But my experience gave the lie to this practice. After every time I sprayed I found I still had pests in the field. With the Field School I learned that there natural enemies and parasites which served to help farmers. Now I don't worry if I have few pests, I know they are food for the natural enemies in my field. I am also frightened to use pesticides, they are poison and endanger not only my health when I apply them, but they also endanger the health of the environment (FAO Technical Assistance, 1998, pp. 161.)

Muhammed Amanah another IPM farmer reported:

> "I commonly sprayed rice as many as four or five times on a schedule. Now I don't spray at all. I also have eliminated spraying my corn" (FAO Technical Assistance, 1998, pp. 161).

Discussions with farmers reveal a variety of benefits related to participation in IPM training, many farmers found that their profits had increased after training. "Because of what I learned in the field school," one farmer from Central Java reported:

> "... my rice yields increased by half a ton. After adding savings from reduced pesticide use, I found that I was able to buy my first motorcycle" (Indonesian IPM Program, no date).

Other farmers remarked that after training they no longer felt pressured to accept the decisions of others, but instead were able to make decisions based on their own knowledge of the rice ecosystem and actual developments in their field. Some farmers emphasized the environmental benefits of IPM.

Moreover, it was not only IPM farmers who recognized the benefit of IPM at the local level. Villages' leaders in many locations praised IPM farmer groups for setting up the first successful rat control campaigns in their villages. Other village officials were so impressed with the gains from IPM training that they set aside village land for IPM demonstration plots. Local governments also took the lead in funding additional Field Schools in their areas so that more farmers can participate in IPM activities.

According to the Community Based IPM Case Studies of 1996, Indonesia at that year had over 10,000 farmers training other farmers. Almost half of the FFSs being conducted under the national program are being conducted by farmers who have gone through one FFS and then were trained as Farmer Trainers in a TOT. These Farmer Trainers led FFS; conducted IPM studies; provided leadership in the development of community level IPM programs; and lobbied at local, district, and provincial levels on behalf of IPM and other sustainable approaches to agriculture (FAO Inter-country Program, 1996). Massive achievements like these will not be possible without IPM employing the FFS system of education. The FFS system changed farmers' ways of thinking; it brought them a sense of; it enhanced the livelihood of farming families. It success was palpable.

Measurements of Success

To measuring the degree of success of the FFS/IPM training program; I have created a list of indicators. Derived from the data presented above, the indicators are as follows:

1. Level of Retention of IPM knowledge and skills gained during the FFS/IPM training
2. Significant changes of alumni attitudes toward application of pesticides
3. Level of support provided by farmer to farmer in IPM activities

4. Spreading the message which resulted in more farmers joining in the FFS/IPM training program
5. Expression of happiness showing alumni have enjoyed the benefits of improved knowledge, skills and practices.
6. Farmers become FFS/IPM trainers to other farmers

Based on collected data, the following chart compared program indicators and their achievements. How successful was the FFS/IPM training program in measuring up to these indicators? Table 5 lists the achievements of the first five years of the program in Indonesia.

Table 5: Indicators and Achievements of FFS/IPM

Indicators	Program Achievements
Level of Retention of IPM knowledge and skills gained during the FFS/IPM training	• There were about 93% IPM trained farmers remaining loyal of their IPM values after FFS/IPM training. • IPM farmers are organizing collaborative projects throughout project provinces. The projects focus on pest control, credit for farmers, seedling production, business enterprises, or simply promoting IPM

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Table 5 continued

Indicators	Program Achievements
Changes of alumni attitudes toward application of pesticides	1. A study conducted in 1993 of over 3,000 field school graduates found that these farmers reduced their use of insecticides by 60% overall, with the mode application frequency falling to zero. 2, The 1991 data presented above by Useem et al., show a 62% drop rate from among over 2,000 farmers in five major regions of Indonesia where IPM program were implemented. 3. The study conducted in 1993 also found that IPM-trained farmers were less likely to engage in prophylactic or "calendar" pesticide applications. The incidence of calendar spraying, in which farmers apply pesticide at pre-determined stages of the crop cycle regardless of conditions in the field, fell by over 50 percent after IPM training. 4. One farmer commented: “In the past I sprayed when the plant was 15 days old and then again when it was 30 days old. In the (training program) I proved to myself that during the spraying, the predators were the ones who died first”.

Continued the next page

Table 5 continued

Indicators	Program Achievements
Spreading the message which resulted in more farmers joining in the FFS/IPM training program	• Farmers have no problems in relating to other farmers, especially in their own village in sharing FFS/IPM training experiences. • Villages where Farmer IPM Trainers live tend to have far more active IPM programs than villages without Farmer IPM Trainers. The informal spread effect of IPM tends to be broader in villages where Farmer IPM Trainers live. • Alumni and Farmer IPM Trainers organize activities to help other farmers learn about IPM. Field studies are used by farmers to demonstrate IPM principles. Alumni organize and re-activate Farmers Groups to provide forums for IPM trained farmers to help others learn about IPM. • Local governments are also taking the lead in funding additional Field Schools in their areas so that more farmers can participate in IPM activities.
Expression of happiness showing alumni have enjoyed the benefits of improved knowledge, skills and practices.	• "Because of what I learned in the field school, " reports one farmer from Central Java, "my rice yields increased by half a ton. After adding savings from reduced pesticide use, I found that I was able to buy my first motorcycle." • After training, farmers no longer felt pressured to accept the decisions of others, but instead were able to make decisions based on their own knowledge of the rice ecosystem and actual developments in their field.
Farmer become FFS/IPM trainer to other farmers	• Community Based IPM Case Studies of 1996, Indonesia at that year had over 10,000 farmers training other farmers. Almost half of the FFSs being conducted under the national program are being conducted by farmers who have gone through one FFS and then were trained as Farmer Trainers in a TOT.

Lessons Learned from Farmer Field School Programs

Russ Dilt and John Pontius wrote a beautiful reflection of "Lessons Learned from Farmer Field School Programs". An experience spread over 9 years of the FFS/IPM program. Russ Dilts was the Director of IPM Inter-country program and John Pontius was a Liaison Program Officer of IPM Inter-country program. I have extracted some data out of their report/manuscript, but the manuscript as a whole is worth reading for its great wisdom and wonderful sharing of experience of the joy implementing the IPM program in Indonesia. For this reason I have included as appendix. Unfortunately I not could find the date of its writing. But a simple time calculation, based on their mention 9 years of IPM experiences suggest a date circa 1995.

CHAPTER 7

VOICES AND ACTIONS FROM THE FIELD

This chapter discusses the main data collected from the field. Data was collected using the techniques I have mentioned in chapter 3, where I discussed the research methodology for this dissertation. Data presented in this chapter reflects all the data collected using various methods, but the bulk of data presented here was main collected using interviews. Personally, I have done in depth and multiple interviews with the main respondents over a four-year period. In 2002, I hired an interviewers via READ, a non-governmental organization (NGO) based in Yogyakarta. The decision made to collect another set of data using comparative interviews, based on the idea of getting different angles or perceptions on some crucial issues as well as to questions missing from the original research interviews. The basic questionnaire consisted of about 60 questions for all three respondent farmers selected, and about 14 to 19 additional questions were addressed to each individual pertaining to issues specific to each one of them.

The Three Progressive IPM Farmers and Agriculture Reformer

The recent history of the reform of Indonesian agriculture can be told in the history three men: Mbah Suko, Pak Murdjiyo and Mbah Slamet. They are revolutionary in their thinking and reformative in their agricultural practices. I interviewed these farmers intensively to learn of their farming experiences, practices and techniques. I considered them advanced and progressive farmers.

They live in three different villages in Central Java and, since they have given me a written agreement to go on record, I will use their names in this dissertation. They are, as I have mentioned above: Pak Murdjiyo, Mbah Slamet and Mbah Suko. Mbah Slamet and Pak Murdjiyo live in two different villages in the lowland but in the same sub-district; Mbah Suko lives in the foothills of Mount Merapi, an active volcano in Central Java, a fertile rice producing area. Pak Murdjiyo is 60 years old, Mbah Slamet is 63 years old, and Mbah Suko is 64. In their lifetimes as farmers, they have experienced four different eras of farming practices and the last of those was a government imposed agricultural programs. These four different eras are:

1. Traditional or Indigenous Agriculture (from beginning – present time): Farmers practicing indigenous farming systems relied on knowledge gained over generations and prior to any encounter with imposed agriculture programs. They learned these techniques from their parents and grandparents. After 1968, these traditional or indigenous agricultural practices were replaced through the government-introduced BIMAS Program. Indigenous agricultural practices varied across the country in the use of seeds, cropping calendars, methods of land preparation, fertilization, and pest control. In central Java, for example, the cropping calendar played a very important role in rice farming. Farmers based the time to prepare their land for cultivation by the appearance of certain stars in the sky and in that way found matched their cultivation to their local climates and seasons. Traditional agriculture never really ceased to exist,

though it was highly discouraged by the government during the period of BIMAS. People who live in the remote areas still practice traditional agriculture.

2. BIMAS or Green Revolution Agriculture (1968 – 1997):

   In 1968, the Government of Indonesia's Department of Agriculture introduced a new, non-traditional program. The government forced farmers to follow instructions on farming practices designed to achieve high productivity. This program relied on new variety of high yielding seeds, inorganic fertilizers, controlled irrigation systems, and the application of pesticides. This marked the beginning of the Green Revolution in Indonesia. Started by The Ford Foundation and the Rockefeller Foundation with the support of the U.S. Agency for International Development (USAID), but its origins go back to 1948 when agricultural scientists began promoting the cultivation of dwarf wheat in Mexico. Certain dwarf wheat could produce yields up to 4 times higher than most of traditional wheat because it is more responsive to urea, an inorganic fertilizer based on nitrogen. The tremendous success of dwarf wheat led to plantings in India and Pakistan and later to China[9]. In 1968 a similar program was started on rice and expanded to include other staple food commodities. Since rice is the major staple commodity commonly planted by Indonesian farmers, any government policy regulating the

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[9] During the period of Cultural Revolution, China never open to Green Revolution, it was possible China took the concept of miracle seeds from the Green revolution and integrated them with their own agricultural system.

production of rice will have significant impacts of the life of many Indonesian farmers.

3. Integrated Pest Management (IPM) Agriculture (1988 – 2000):
   A program introduced in 1988 by the Food and Agriculture Organization (FAO) of the United Nations, which promoted an ecological approach to farming practices. Farmers were trained to observe, analyze and do research on their crops on a regular basis and to understand the ecological relationship between their crops, pests and enemies of the pests. IPM techniques discouraged the use of pesticides because they disturbed the ecological balance between the pests and their enemies. The program encouraged farmers and improved their analytical skills, and allowed them to be the decision-makers and managers of their own farms. The Department of Agriculture allowed IPM approaches within the BIMAS agricultural system to remedy problems related to several major Brown Plant Hopper (BPH) outbreaks on rice.
4. Going Beyond IPM towards Organic Agriculture (2000 – present):
   In order to improve their farming practices, IPM farmers further pursued their indigenous agricultural practices as well as their own innovations based on research and analysis. The IPM approach used environmental friendly relied on two major principles: (a) maintaining high productivity by (b) the use of environmentally friendly practices. Post-IPM farmers became organic farmers and applied the organic and agro-ecological approach (OAA). Through this approach these farmers reinvented many

of the indigenous practices banned during BIMAS or the Green Revolution era. In 2000, the Department of Agriculture of Indonesia endorsed this organic and agroecological approach by launching "Go Organic by 2010".

Although both IPM and OAA are agro-ecological systems of agriculture, IPM and OAA differs in two ways:

1. IPM allows the application of narrow spectrum[10] pesticides as a last resort to safeguard the harvest when the pest population exceeds a certain "threshold" level. In practice, however, IPM crops should not require the use of pesticides.
2. IPM takes a neutral stand regarding the application of inorganic and fuel based fertilizer. However, many IPM trained farmers learned through agro-ecological analyses that inorganic fertilizers such as urea (nitrogen fertilizer), NPK and KCL render soils hard and may cause fertilizer burn[11]. In order to improve their soil, many IPM farmers refused to apply any more of inorganic fertilizers. Reverting to indigenous agricultural practices, they applied compost produced from their fields' biomass[12].

IPM deliberately left these options open to assure the consent of the Government and political acceptance during its inception at the height of the Green Revolution era. This was a brilliant strategy, preventing rejection of IPM. I chose the four milestones or eras, above, because they mark significant changes

[10] Narrow spectrum pesticides are also known as target specific pesticides that doesn't kill all.
[11] Fertilizer burn is caused by the application of too much inorganic fertilizer to the crop. An excessive concentration of chemical fertilizer around the plant does dehydrate and kill the plant.
[12] Biomass of a rice-field is the leftover of the rice crop after harvest.

in the lives of many Indonesian farmers, as well as farmers around the world. They also illustrate how various agricultural practices affected the interests of farmers, of the governments and corporations and how they affected the people and environment. Farmers at the frontlines of this struggle experienced the primary impact of their new agricultural behaviors and practices. The three farmers were interviewed separately. They answered 60 detailed questions categorized in 8 different groups:

1. Their personal reaction responded to conventional farming imposed by the Indonesian government, in contrast to the traditional agriculture practiced prior to 1968.
2. Their personal feelings and thoughts reacted to the introduction of IPM as an alternative farming method in 1986.
3. Their experiences as IPM Farmers
4. Their involvement in the agricultural teaching and learning process and dissemination of knowledge is significant.
5. Dissemination of IPM knowledge through training to other farmers
6. The have significant involvement in training of woman farmers groups and schoolchildren in reaching out a broader group of farming communities.
7. They have significant involvement in farmers' science meetings, reviewing and improving indigenous practices to increase their productivity. After the introduction of IPM, many IPM farmer explored research initiatives to improve their farming practices.

8. Their involvement in the National IPM farmers association (IPPHTI), founded after the national IPM program ended, at the end of its term and funding by FAO or other donors had ceased.

These questions were designed to help them describe their experiences in traditional, conventional, and alternative farming, and to help them share their discoveries in devising a new process of learning. Moreover, I constructed about 14 to 19 additional questions to analyze issues specific to each of the three subjects. My main goals in asking the additional questions were: (1) to find out how do they obtained their knowledge; (2) how they shared this knowledge with others; and (3) to encourage them to compare the advantages and disadvantages of various agricultural methods they have practiced in their lifetimes.

Finally, I devised a third set of highly individualized questions for each of the three farmers to address their specific farming styles.

Mbah Suko's questions pertained to:

- Local rice seed propagation
- Rice cropping and fish rearing farming combination
- Formulating home-made bio-agents, such as pest repellents made from plants and his formula for green liquid fertilizers
- Spider farming to propagate spiders to be released in his rice field.

Pak Murdjiyo was given additional questions pertaining to:

- Formulating natural ingredients in order to make pesticides and insect repellent from various natural ingredients such as bitter leaves and beetle nuts
- Formulating home-made natural "bio-pesticides"[13] and "bio-fungicides" such as *Beuveria bassiana* that controls *coleopthera* and beetle families (such as brown plant hopper), and *Trichoderma sp.* that controls *Fusarium sp.*, a fungus that causes leaf and root rot. Fusarium also produces mycotoxins, *fumonisins* that causes neurological disease in farm animals and humans. (AgNet, 2004)
- Reinventing and formulating pest/insect repellents to control pests
- Farming techniques to increase the yield of ground nuts

Mbah Slamet's was asked additional questions about:

- The relationship between IPM and animal husbandry
- IPM training for women and school children
- The adoption of the ancient Javanese agricultural almanac into current agricultural indigenous practices.

BIMAS or Green Revolution Farming Practices

All three farmers explained that participation in the BIMAS program was not voluntary. The Department of Agriculture through its extension agents required them to follow instructions. The farmers were in no position to resist. In

[13] The term "bio" for short of biological is used here to show that these are micro-organism which is propagated to be used as natural pesticides or fungicides. Some bacteria and enzymes are also used to generate natural fertilizers. Uses of bacteria can shorten the time needed for composting process to only 14 days.

1969, when Indonesia introduced the BIMAS program for rice, new techniques of rice farming imposed on farmers. They included:

- The use of IRRI[14] high yield variety seeds such as IR36; IR 64; these were also introduced as BPH resistant varieties and known to farmers as *Varietas Unggul Tahan Wereng* or VUTW.
- Promoting the application of inorganic fertilizers like Urea (Nitrogen fertilizer), TSP (Triple Super Phosphate), NPK (Nitrogen-Phosphorus-Potassium), and KCL (Potassium Chloride)
- The use of pesticides to control pests
- The use of herbicides in some weed-infested areas
- Government provided technical irrigation in some areas
- The use of manufactured plant growth hormone in the agricultural credit scheme package introduced to the farmers in the late eighties when BIMAS was elevated into INSUS and SUPRA INSUS.

This later program was wrapped in an incentive credit package of agricultural inputs that included some cash-credit to pay for the labor in getting in the rice crop. The cash credit was the major incentive for the BIMAS program. Farmers who found themselves in need for quick cash would go for the BIMAS credit package despite all of the difficulties they might face at the time they have to pay it back. This cash incentive for payment of labor had also been identified as one of the sources of corruption in the BIMAS agriculture system.

[14] IRRI –International Rice Research Institute in Los Baños, the Philippines.

In 1980, the BIMAS program was highly intensified, with INSUS and SUPRA INSUS[15] setting a target of 2 to 3 rice crops a year on irrigated land. Farmers had to follow strict government instructions on what variety to plant and when to plant in a certain *hamparan (*an area of rice field surrounded by natural or man-made boundaries like villages, rivers, foothills and forests). The Government also determined what agricultural inputs were to be used. In the BIMAS - SUPRA INSUS program, for example, farmers were required to apply growth enhancement to their rice crops as part of the credit package.

As part of the BIMAS Program, the Department of Agriculture installed the Plant Protection Division with the stated purpose of safeguarding farmers' crops. The Division assigned pest observers, one to every sub-district where rice crops were planted. The field pest observers reported directly to their Supervisors at the District Office, which would respond by providing instructions to farmers on how to protect their rice crop. Often the farmers were instructed to apply certain pesticides to overcome the identified pest problem. When the IPM program was introduced in 1986, the pest observers at the sub-district level were the first groups who received IPM training and then IPM Training of Trainers.

The disastrous consequences of the newly intensified BIMAS rice program were soon apparent. The official target of two or three crops a year set up conditions that resulted in outbreaks of Brown Plant Hopper (BPH) in 1984. Land areas or *hamparan* planted continuously with rice provided ideal breeding grounds for brown plant hopper (BPH) as they guaranteed no break in the life

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[15] The intensified (INSUS) and highly intensified (SUPRA INSUS) of BIMAS program package were launched with the country's presidential special instruction in the late eighties to optimize Indonesia agricultural production on rice.

cycle of the pest. These outbreaks wiped out the rice crop in all the major "rice bowl" areas in Java. Farmers in these prosperous planting areas suffered three consecutive crop failures that resulted in famine and starvation.

It was at this time of crisis that the IPM program came to the rescue, not just as scientific entomological technique but also as an educational system. The beneficial impact of the new educational methods can best be documented in the work of the three IPM farmers singled out for analysis.

The three farmers I interviewed explained that after 1988 the Integrated Pest Management (IPM) Program and the Food and Agriculture Organization (FAO) presented excellent alternatives to the BIMAS program. IPM Introduced the new method of ecological analysis, training farmers to observe their rice fields and to analyze ecological relationship between the rice crop and insects and animals around it. IPM training taught farmers to identify which insects damaged the rice and which were benign. They learned about the natural enemies that preyed on harmful insects. IPM training taught farmers that indiscriminate applications of pesticides killed both the pests and their natural enemies, disturbing the ecological balance. A different and more benign revolution had started, and at its core was a new educational methods.`

The Narratives of Three IPM Farmers

The great change in agricultural and educational methods is best described and understood as in the experiences of three individual farmers in the four different agricultural eras outlined above. The three narratives are based on interviews using the questionnaires listed in Appendix B, as well as personal notes taken on prior and subsequent visits. I have chosen this narrative form so that the farmers can speak directly to the reader without the filters and interpretations interposed by the phenomenological approach.

The three farmers I selected are Pak Murdjiyo, Mbah Suko and Mbah Slamet. Pak Murdjiyo is one of the leading farmer in doing researches and innovations, for this role, in 2003 he was nominated as one of the candidates for Kalpataru Award, a national award recognizing individual initiatives in preserving the environment ; Mbah Suko, the heirloom/local rice breeder, preserver of many lost heirloom rice varieties. In 2001, he won a Kehati Award as the preserver of the environment. This award is recognition of the National Consortium of Civil Society for his tireless works in preserving a total of 34 heirloom rice varieties; and Mbah Slamet, a retired veterinarian who found IPM practices match with animal husbandry and feeding healthy food to cattle and small ruminants such as sheep and goats. Although he received no awards or being nominated to receiving one, he is also tirelessly works to practice farming activities following the organic and agro-ecological approaches as suggested by the IPM program.

Pak Murdjiyo, a Farmer-Innovator-Researcher

Pak Murdjiyo was one of the first participants of IPM Field school training conducted in Central Java when it was introduced by IPM National program and run by FAO. Not long after completion of this training, and having had some time to apply IPM principles and practices, he was invited to take part in IPM Training of Trainers (TOT) and was invited to a regular Farmers' Science Meeting.

Pak Murdjiyo was born in Bantul in 1942; he was 62 years old at the time of the interview. He is married and blessed with three children who are now all grownup. His wife and two of his children currently help him on the farm. Before he was a farmer, he was a lower ranking military officer in charge of local intelligence coordination at the sub-district level. After his retirement from the military when he reached 55, he adopted farming as his next profession. Soon after, he was elected as *Kepala Dukuh* or hamlet chief. So he is a farmer holding a local leadership role.

The 1965 tragedy marking the collapse of Communism in Indonesia and the take-over of power by the military determined the farmer's fate for many years to come. Farmers still feel the effects of oppressive government practices that were imposed on them during that time. The 1965 collapse created a traumatic situation for farmers, because the government had been exercising iron-fisted policies in agriculture. Shortly thereafter, the Soeharto military regime embraced the worldwide campaign of Green Revolution. The government instructed Indonesian farmers to adopt Green Revolution – the BIMAS modern agricultural system.

Pak Murdjiyo, along with some other farmers decided to join, When IPM was introduced to farmers around 1988. They saw IPM as a program promoted changes in their current farming practices. He perceived that the IPM program represented an autonomous agricultural model, independent from outsider controls.

BIMAS in Comparison to Alternative Agriculture

Pak Murdjiyo had engaged in farming before the BIMAS program was introduced, increasing his time since he got married. At that time he followed farming methods taught by the ancestors. That farming system did not employ any factory made chemicals (such as inorganic fertilizers), pesticides or hybrid seeds. At that time, farmers engaged in a natural form of farming in which they were independent and able to determine the most appropriate way to manage their farms.

After the introduction of BIMAS, he was instructed to plant a type of rice that was determined by the Government and would require certain fertilizers. Although he and many other farmers were not agreeable to this program, the fact that he was also still in the military meant that he was not in a position to object. Pak Murdjiyo and his colleagues decided to set aside small plots where they could still practice old-time farming without chemicals, and not openly oppose or fight the government program. He and others feared that the new program would eventually eliminate the natural techniques they had inherited from their ancestors.

Beginning around 1980 farmers became aware of the techniques the government used to gain acceptance of the BIMAS program. Through invitations and other persuasions designed to draw their interest, farmers were lured into the program. Whether they agreed with its principles or not, they were required to participate. After observing the phenomenon of so many fellow farmers becoming dependent on inorganic, factory-produced agricultural inputs, he realized that these manufactured products would eventually enslave farmers on their own land. They would be unable to act freely as independent farmers and human beings with the personal freedom to plant or do what they liked on their land.

Pak Murdjiyo charges BIMAS for the loss of *gotong-royong*[16] communal spirit of cooperation. He values this *gotong-royong* spirit as the binding power among people in traditional farming communities. BIMAS model of agriculture relied too much on the cash system for buying inputs and selling the farm outputs. BIMAS reduced many richly social and cultural interactions among people in the farming communities and deformed them into a simple financial calculation of costs and benefits. After the IPM programs were introduced, farmers began slowly transitioned to alternative agriculture[17] models and the BIMAS model that was previously prevalent became rare.

In 1982 Pak Murdjiyo began to develop and experiment with an alternative agricultural model. It was simply to farm completely without chemical fertilizers. At that time this idea was heavily challenged, not only by the government bureaucracy but also by fellow farmers. When Pak Murdjiyo retired from the military service in 1992, he continued to explore this alternative agriculture. By 1994, he was no longer using any inorganic chemicals in his farming activities.

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[16] *Gotong-royong* means mutually benefiting cooperation among community members in helping one another to accomplish a job too big for one person or a small group of people. Building a house or fixing communal access roads are commonly done in *gotong-royong*. If the job is for helping individual member project, reciprocal favor is expected.
[17] Alternative agriculture designated to agriculture system that is different than BIMAS agriculture system. This includes indigenous/traditional, IPM or organic system of agricultures

An important challenge for alternative agriculture is how to convince other farmers to adopt new ways of approaching many different aspects of farming. Changes which are regarded as positive would include the use of draft animals to prepare the land, and the planting of local seed varieties. Local plants are preferred for their taste and their adaptability to local climate conditions. The use of natural fertilizer (i.e. compost) rather than inorganic chemicals yields lower costs and healthier soil.

Local rice varieties play very important role in the new agricultural approach, besides giving pleasant aromatic rice flavors, which are highly preferred by the market, they also grow well and more responsive to composts fertilizers. Although Pak Murdjiyo does not propagate local or heirloom rice varieties, however he did manage to preserve some of this rice, which he planted in his plot. Some of the local or heirloom rice he and his fellow farmers preserved is *Rojolele, Pusaka and Selegreng*. Pak Murdjiyo also experimented with some of the hybrid varieties such as Jasmine-scented rice and IR64[18]. The hybrid varieties were planted without applying chemical fertilizers, but the results were not optimum. Their method of preserving this heirloom rice is as follows: First, they seek out the heirloom varieties and obtain seeds to start (starter seeds[19]). These seeds are then planted, and multiply until they have a sufficient amount of stock seeds. They then set up a kind of seed bank or the seed barn and make them available to other farmers.

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[18] IR64 is one of the most popular IRRI rice for its better tastes and aroma and yet has the brown plant-hopper traits of resistance to disease and high yields.
[19] Starter seeds are just a handful of seeds or a panicle of rice grain to be grown for the purpose of multiplication.

Pak Murdjiyo believes that pengedalian hama terpadu (PHT) or IPM principle is effective in identifying any early pest attack and crop problem by carrying out direct observation in the rice field. After identifying a pest problem, Pak Murdjiyo controls the pest population by making use of materials that are available from local surroundings. He also tried to raise the population of the pests' natural enemies in his field to fend off the attack. As an IPM practitioner he holds to the principle that growing a healthy crop promotes natural enemies and he carries out routine observation of the field. Embracing the IPM principle Pak Murdjiyo steps even further into ecological agriculture by avoiding the use of any inorganic chemical products and uses all available materials from his surroundings. He observed that the use of urea and other manufactured fertilizers make the soil hard.

Pranoto Mongso – Ancient Farming Almanac

Pak Murdjyo makes use of *Pranoto Mongso* or Ancient Farming Almanac in his farming activities; there were two versions of *Pranoto Mongso*. The original almanac uses the calculation based in the Javanese calendar and the other is its adaptation to the international calendar. A later version is a modification of the lunar calendar system to a solar calendar system similar to the international calendar. This almanac depends on a calculation of the days and the (Javanese) weeks[20] to determine the season, and instructs the farmer when to plant a variety of crop that matches that season. For example, if a farmer wants to plant the secondary crop, s/he will choose the kind of crop that matches the crop

[20] Number of days in a Javanese calendar week is five days: Wage, Pon, Pahing, Legi, Kliwon. Javanese calendar is a lunar calendar.

suggested by the almanac. The almanac also advises what day is best to plant, how the crop should be planted, and what factors the farmer should pay attention to during that cropping season. For example, September is suitable for planting rice as well as other crops that require a lot of water.

Nowadays, according to Pak Murdjiyo, P*ranoto Mongso* indeed needs modifications. However, he feels that the main principles and the basic foundation should be kept intact. One of the major reasons for modification is the change in the earth's climates, making the seasons harder to predict. So he thought this modification would be more useful for a farmer's management and help him understand the agricultural technology needed for adapting to the changes in the environment globally. For example, in order to plant his rice crop, a farmer needs to know how long until it will to be ready to harvest. He also needs to know how many panicles the rice should have to indicate that it is mature. The Year of the almanac is divided into 12 different *mongso,* or time periods, and farmers need to know what to expect during each of these periods. Pak Murdjiyo believes that modifications of the almanac calculations are necessary because the weather is becoming very difficult to predict. Days are rainy when they should be dry and dry when they should be rainy. He believes that the unpredictability stems from the effects of global climate change. These factors make it difficult for farmers to practice *pranoto mongso, and Pak Murdjiyo* suggests that farmers should do their part to help prevent factors that affects further global climate changes in the future.

Compost and Natural Pest Control

In addition to the main crops, Pak Murdjiyo also grows other plants in the compound around the house. These are plants he can grow for additional food supplies such as yams, taro and vegetable plants, or plants he can use for making natural pest repellents or pesticides. Pak Murdjiyo is also keen to study the relationship between pests and their enemies. He works on developing natural ingredients he can use to control pests. He believes in the IPM principle of observation in order to establish the relationship between a pest and its natural enemy. For example he works in isolating and growing non-pathogenic fungi spores that can kill the pests or *Trichogramma sp.,* a wasp that is parasitic on the eggs of certain pest, such as the Asian corn-borer (ACB). Pak Murdjiyo always emphasizes the importance of dialog and the use of available natural materials that are affordable and easy to find. All of the remedies listed above are easy to produce and friendly to the environment.

Compost is made of leaves collected around the house and from harvest leftover from the fields. Compost is very useful in traditional agriculture and is easily made. The composting process can be accelerated by putting decomposer bacteria in the compost mix and maintaining the correct humidity of the materials. Pak Murdjiyo also produces liquid green fertilizer made from leguminous tree leaves rich in Nitrogen. This homemade fertilizer also improves the soil's nutrition and enhances the plants' growth.

Farmers can plant the compound around the house. Plants like *Neem* (*Azadirachta indica*) local name: *nimba* or *mindi* and *Brotowali* (*Tinospora* *crispa*) yield bitter extracts that are effective green pesticides and repellents. Application of these plants extracts control certain pests like caterpillars, aphids and thrips. The extract can be prepared by grating or pounding plant parts (leaves, roots and twig/barks) and then boiling them. When the mixture has cooled it is filtered to separate the debris. The resulting extract, which is full of active ingredients, can then be diluted, and used as a spray to discourage insects. Marigold is another plant can be used effectively as a natural pest repellent especially against aphids and trips. Plant Marigold at the edge row or intercropped with crop plants to repel pests. Its leaves can be used as a natural pesticide and an extract of its flowers can be applied to mature crops to increase the amount of bloom and thus increase their yield.

Pak Murdjiyo also learned some pest control techniques using fungi. Just as penicillin fungus can kill other pathogenic fungi and bacteria, *Trichoderma sp.* is very effective in controlling *Fusarium sp.*, a fungus species that cause leaves and roots to rot in rice and secondary crops. Another fungus, which is used as a pest control, is *Bevaria bassiana*. This species is effective in controlling the *coleoptera* insect family. Some of the most obnoxious pests of the *coleoptera* family are the brown plant hopper (BPH), green plant hopper (GPH) and rice seed bugs (*Leptocorisa acuta)* -- local name: *walang sangit*. *Bevaria bassiana* fungi are extracted from insects that died of *Beuvaria bassiana* infestation in their bodies. These are easily identifiable as the white mold of fungi is visible all over their bodies. The fungi is then grown in a rice medium in order to create the spores which will be used later to control that pest. The rice that was used for fungi production is ground to powder. Powder is then mixed in the sprayer tank and applied to the crop.

Pak Murdjiyo learned how to propagate spores from dead insects (of the coleopteran family such as brown plant hopper and rice seed bug) by working in co-operation with the University. He learned how to differentiate between useful, non-pathogenic microorganisms and microorganisms that are destructive to crops. He learned the difference between spores that are friendly and useful to farmers from the destructive type. Extracted spores are grown in a homemade media like boiled cassava or half-cooked steamed rice. These preparations are then put in a simple, locally made wooden incubator in order to maintain the spores in a contained environment. Containment is prepared by simply putting them in clean plastic bags or plastic containers.

Cost/Benefit Analyses

The financial benefit of alternative agriculture is a combination of the low cost of production paid by the farmer, and the market value, which is higher than chemically treated rice products. Pak Murdjiyo also emphasized that IPM farming is very effective in comparison to BIMAS and he cited as an example the utilization of compost. He found that by using compost, he could grow crops whose yield was equivalent to those produced under the BIMAS system. After several years of applying alternative farming methods, his results improved to the point that he could easily exceed the yields produced in the BIMAS model. However, he found that some of the farmers were, and still are, afraid to switch to alternative agriculture because they still see it as risky. Some of the government extension agents were successful in convincing farmers that if they didn't follow the BIMAS model, they might not realize any harvest at all.

Pak Murdjiyo made a calculation to prove that crops produced by alternative agricultural methods were less costly to produce than those produced under BIMAS. He made a comparison of the cost of production for a 1,000 meter square plot. If using the BIMAS model it would cost the farmer between ID Rp. 600,000.00 to ID Rp. 700,000.00. At that time the conversion rate was ID Rp. 10,000.00 equivalent to US $1.00; at this rate the cost was $60.00 - $70.00 per thousand square meter of land. This computation included the cost of labor for land preparation, seeds, agricultural inputs, and pesticides. By using alternative agricultural methods, the cost was reduced to only ID Rp. 550,000.00 or about $55.00. While it was true that farmers spent more on labor, they also cut the cost of fertilizers, pesticides and seeds significantly. The savings realized on input costs was between ID Rp. 5,000.00 and ID Rp. 15,000.00, but compared to a day's labor, this saving was significant.

Pak Murdjiyo compared the price difference between manufactured and homemade fertilizer. One liter of factory produced liquid fertilizer was sufficient for 4 applications to 1,000 square meters of plot and cost farmers ID Rp. 17,500.00. With the same amount of money, a farmer could make 50 liters of liquid green fertilizer, which was equivalent to the manufactured product. The liquid green fertilizer is made of leguminous tree leaves mixed with water and sugar so it would stick to the crop leaves and is applied with spraying equipment.

He further stated that alternative agriculture saves farmers even more when they use compost. Compost application brings more than just financial benefits, it also improve the long-term condition of the soil. It aerates the soil and improves soil texture. By preventing the formation of hardpan, compost makes the weeds easier to pull. The long-term impact is healthier soil and an improved environment.

As regards the cost analyses, Pak Murdjiyo shows that alternative agriculture lowers the production cost. Then he went further with his analyses on the results side of the calculation. He stated that alternative agriculture brings better results when compared to the BIMAS model of agriculture. Initially, at the beginning of the switch, production will decline. In the first planting season around 15-17% lower yields will occur, but as the soil structure improves farmers will see better yields. Comparing his own experience, Pak Murdjiyo said that a piece of land farmed using BIMAS system usually could produce a maximum of 600 – 700 kilograms of dry unshelled rice per 1000 square meters. But by using compost combined with other alternative ways, he could produce 720 kilograms of dry unshelled rice. Farmers practicing alternative agriculture enjoy a long list of benefits. Furthermore, when farmers plant heirloom or local varieties like *Mentik Wangi* and *Pandan Wangi*, they will enjoy higher benefits because these heirloom varieties are more responsive to compost and produce highly aromatic, tasteful rice, which sells for higher market price.

Another benefit from alternative agriculture is that farmers enjoy a much higher selling price. Hospitals and health conscious populations look for healthy rice, rice that is grown naturally without inorganic chemicals. Pak Murdjiyo reported in 2000, that market retail price for non-chemically grown heirloom rice is between ID Rp 3,300.00 – 3,600.00 per kilogram while IR64 BIMAS rice sells for ID Rp. 2,400.00 per kilogram. This calculates to about a 37.5% to 50% higher selling price. Therefore, even then during the transition period when yield drops by about 15-17%, the higher selling prices of non-chemical rice would easily cover this temporary loss. In addition, when a farmer's plot improves by consistent farming practice using compost, local/heirloom seeds, and all natural ingredients for controlling pests; farmers would enjoy significantly higher benefits than what the BIMAS system could provide. His only frustration is that although most of his fellow farmers have seen what he has done in term of practicing alternative agriculture, there are still farmers who stick to the BIMAS farming system. As their rice plot locations are neighbors to one another; Pak Murdjiyo complains about the pollutants that are potentially migrating from the neighbor's plot to his.

Pak Murdjiyo shared that the good things he learned from BIMAS system of agriculture are a number of principles, which also known as "good farming practices" such as maintaining good irrigation, balanced soil nutrients, and use prominent seeds. However, this translates to Pak Murdjiyo in a new meaning of alternative agriculture, i.e.: irrigate the crop sufficiently but at the same avoid the impact of pollutants that leach from neighbors plots; use compost to maintain balanced soil nutrients and use local or heirloom seeds that are responsive to compost and will grow optimally in a natural soil ecology.

Pak Murdjiyo has completely stopped using any chemical inputs in his farming practices, especially on rice. If it were now suggested that he go back to BIMAS farming system, he said he would reject this suggestion. Even if he were forced to practice BIMAS, he would oppose it because BIMAS is doing damage to the environment and has made farmers become dependent on manufactured, inorganic products that profit huge corporations. He further mentioned that prior to the introduction of BIMAS in 1968; farmers here used composted leaves collected from the compound around the house, and from the field, green leaves to be used as fertilizers. Therefore, farmers from this region have practiced alternative agriculture they learned from their ancestors.

Pak Murdjiyo is a strong proponent of traditional agricultural practices. He remembers that old time farmers were using aroma to attract or to repel certain insects. Farmers used anything with a strong, bad, rotten smell to attract them and stinging smells to repel them. The stinging smell of ginger roots are known to repel *walang-sangit* or rice seed bugs (*Leptocorisa acuta, Leptocorisa oratorius*), while the smell of dead yuyu sawah or fresh water crab (*Buruquena Sp.*) attracts them. The purpose of attracting rice seed bugs was to collect them and kill them by burning. Please see more about using dead freshwater crab to trap rice seed bugs in the collection of known indigenous or traditional agricultural techniques collection listed in Appendix C.

Pak Murdjiyo's opinion of the BIMAS program is mainly negative. He sees BIMAS as responsible for the destruction of inherited, traditional agricultural techniques, damage to soil as it becomes hard from prolonged applications of inorganic fertilizers and poisoning of farmers and their environments. For all of the above reasons, he is ready to fight if the government again tries reintroducing BIMAS to the farmers. He remembers that he was ready to refuse BIMAS when it was introduced the first time but could not because he was still in the military. Now, with the IPM knowledge, he knows he would refuse BIMAS completely.

Getting Involved with the IPM

Pak Murdjiyo first learned about the IPM program when he was still with the military. He remembers how he encouraged farmers to join the IPM Field School training known in Indonesian as Sekolah Lapangan Pengendalian Hama Terpadu (SLPHT). He was one of those who joined in the first training sessions of IPM. At the time IPM was introduced there was still an open window for pesticide use, although this was only as a last resort to safeguard the harvests. From the beginning, IPM approaches differed from BIMAS. The BIMAS model always emphasized the package of delivery concepts, provided to farmers wrapped in the credit scheme, which include inorganic fertilizers, pesticides and money to pay the labor. In contrast, IPM always encouraged farmers' freedom to make the best decision for them. Farmers are free to decide what crop to plant and how and when to plant it. In BIMAS, this freedom and farmers' independence perceived as a rebellious attitude. Speaking his mind about IPM, Pak Murdjiyo was amazed to find how IPM became the most reliable system for managing pests. IPM agricultural practices never suggested any application of pesticides as BIMAS does. BIMAS pesticide application kills pests but all the benevolent insects that prey on pests are also killed. He should avoid this practice. Those pests' enemies should left intact so they can function in nature to maintain ecological balance.

Pak Murdjiyo suggests the following points of consideration when practicing alternative agriculture:

- Understanding of quality of the land: is the soil damaged and in need for repair?
- Maintain good understanding of soil ecology: soil contains a massive population of living organisms; most of them are beneficial to the crops.
- Manage efforts for soil restoration when necessary.
- Use or selection of fertilizers: organic or natural fertilizers such as compost would be the most appropriate selection. Compost is known to be the best way for repairing damaged soil by putting back organic matters into the soil and making dead soil come back to life.
- Use or selection of seeds: find and select seeds that are most responsive to compost and Organic and Agroecological Approach (OAA). Many heirloom or local seeds are better suited to this purpose as they respond better to compost, manures and other organic fertilizing methods.
- Plan the planting calendar: consider the local climate and seasons as major factors in planning. The well-known local agricultural almanac would be useful for planting.
- Manage the irrigation: ensure that water comes from the neighbors' fields does not carry much inorganic material or residues. Work cooperatively with neighbor-farmers so they do not create pollution in the area.

- Analysis of the farming practices: do a regular agroecological analysis of your own farming practices. A weekly observation and analysis would be a good practice.
- Have a good understanding of the agro-ecological system and inter-relationships between crops and natural living organisms.

He holds these principles to be the heart of his farming practices and he never uses manufactured products. He is moving entirely to applying the organic and agro-ecological approaches (OAA). In 2003, the government of Indonesia (GOI) Department of Agriculture declared to "Go Organic by 2010", Pak Murdjiyo responded to this government policy decision enthusiastically.

Besides farming, Pak Murdjiyo mentioned the necessity and the urgency to create better market access for environmentally friendly agricultural products and for the government to create policies to protect the interests of the farmers; especially in adopting the alternative agricultural technologies. He also points out the necessity for cleaning the water used for irrigation. The water quality currently used by farmers is poor, polluted with chemicals. This polluted water will have impacts on their agricultural products. He is exploring methods for making use of ground water in his alternative agriculture, water that is clean and has never been contaminated with agricultural pollutants.

Pak Murdjiyo carries out his own research. He performs research tryouts on his personal plot. Only after identifying some successes of these trials and assessing their potential impacts, will he start spreading his research findings to other farmers. So they too can enjoy the benefits of his innovations. The common field test he uses in his research is making comparisons of three different plots of 1000 square meters each. For example, one plot is treated with all chemicals, another applied with 50% chemical treatment, and the other is treated with no chemicals at all. Results are evaluated by comparing the yields and the net income generated to the farmers. He thus became a teacher, an educator.

Pak Murdjiyo would like to see more public and social support for alternative agriculture. He mentioned how governments can create policies that protect farmers from being flooded by manufactured agricultural input products and the use of social campaigns geared towards promoting organic or environmental agricultural products. He also proposes that governments issue policies that protect biodiversity of the food crops. He clearly sees the danger that market selection of agricultural products could easily be a filter that strains out all but a few products planted by the farmers and sold in the market. He also shared how the academic communities have been very supportive to farmers' initiatives and innovations by strengthening farmers' research with their own rice fields. Cooperation with university research will encourage more farmer exploration in search of better alternative farming practices. He calls all these supports as moral support that will strengthen farmer efforts to boost their alternative agricultural production.

Pak Murdjiyo made significant efforts in searching and revisiting many indigenous, traditional agricultural practices and in some way is able to improve these practices with his research and innovations. Many of these practices are quite well documented and are listed in Appendix C. Appendix C of this dissertation consists of compilation of indigenous agricultural practices, farmers' innovations in improving traditional agriculture and some new highlight or new concepts of agro-ecological understanding through research.

Sharing the IPM Ideas and Experiences

Pak Murdjiyo is keen about sharing his ideas and experiences involving IPM farming practices. He started with IPM as a motivator and he is now an IPM trainer. As a trainer, he is often invited to speak in various seminars, workshops and informal sharing of experiences discussions. Whenever he has the chance, after a training session, Pak Murdjiyo will run a practical demonstration in a farm plot. In 2001, he was invited nine times to speak or give training about IPM. In 2002, he was invited eight times to speak in the Yogyakarta area as well as outside Yogyakarta. He is often invited as a pro-bono speaker to academic forums (students and professors), farmer groups, and agricultural companies promoting organic and agro-ecological practices. He never expects payments when he is invited to speak. He finds personal satisfaction knowing that farmers can gather and solve their problems in the field. As people came to appreciate his speeches, he started to receive better payment. However, no matter how big or small the payment, or even for no payment at all, Pak Murdjiyo is always happy to talk and share his experiences with IPM on any occasion. He believes that he is invited so often because he practices these techniques himself and people see that he preaches out of his experience. In addition to sharing what he knows, he is also an ongoing learner. Every time he pays a visit to another farmer group, he is always open to learning from their experiences as well.

Pak Murdjiyo was also active in sharing his IPM experiences with other farmers around the village or some times at a greater distance. Farmers also come and visit him at home to discuss their farm activities and technical problems as well as its social impacts. Normally they also come, visit his plot, and expressed that they would like to do his agricultural model. He was invited to talk in some other places within and outside the province. He traveled to Central Java area to places like Solo, Kulon Progo, Purworejo, Magelang and to Garut in West Java.

Among mostly male farmer groups, Pak murdjiyo had an opportunity to train the only female farmer group in Imogiri sub-district, the same sub-district where he lives. He commented positively on women farmers' participation in his training sessions. Women farmers are more enthusiastic and tend to be more attentive, patient, and willing to do more of the field practices. He observes that women farmers are more responsive to participating in the IPM field school, especially when they learned that IPM focuses on family health and cost savings in farming activities in comparison to the BIMAS model. They clearly see that IPM helps them save and improve their family economy. He recognizes that women play a very important role in the family farming activities. In contrast to the women, the male farmers are normally tired when they come to the IPM training and for this reason they become less attentive and less energetic when compared to their women counterparts.

Pak Murdjiyo claimed he was active in the farmers' science meeting[21]. He started as one of the participants then later became one of the speakers in the meetings. He doesn't follow on this activity regularly because of his limited time and so many things to do. But he believes the science meeting is a very useful way for farmers to share their experiences, discuss their problems, and together find solutions. He presented an innovative idea about Beuvaria bassiana, one of the beneficial fungus species he uses for making bio-agent[22] effective for killing *walang sangit* or rice seed bugs (RSB) and brown plant hopper (BPH).

Farmer Meetings

I would like to insert a clarification note here. I think this note is crucial in helping readers understand the broader context of the after IPM training activities. Beyond the completion of FFS/IPM training the IPM training alumni were encouraged to participate in the FFS/IPM follow-on activities. Among others the Farmer Planning Meeting and the Farmer Technical Meeting appear to be key activities in furthering the development of community IPM programs.

Farmer Planning Meetings:

- are a forum where alumni from different villages get to know each other and learn about what they have in common as IPM alumni hence a network develops

- provide alumni from villages across one sub-district the opportunity to develop village IPM program plans and coordinate implementation of program plans on a sub-district scale; (Dilts and Pontius, no date)

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[21] Farmers Science meeting was originally formed and facilitated by the IPM national program to encourage farmer research and innovations based on their daily experiences in their fields. Later, this meeting was organized by IPPHTI (National Association of IPM Farmers)
[22] Bio agent is a non-pathogenic micro-organism used in IPM and organic pest control

The above farmers' meetings involved FFS/IPM alumni living near one another or sharing the same *hamparan*, a vast area of rice fields contained within natural or man-made borders. The meetings took place in a sub-district location, which allows farmers from neighboring villages to attend. The agenda of the meetings include ways of applying and evaluating IPM methods.

Farmer Technical Meetings also known as Farmer Science Meeting:

- They are forums where alumni learn about the results of activities conducted in other villages in their sub-district, they motivate alumni to try new ideas
- They provide alumni the chance to discover the importance of sharing information across a sub-district
- They help alumni improve their own village level IPM activities based on the experiences of alumni in other villages (Dilts and Pontius, no date).

Other post FFS/IPM training activity open to FFS/IPM graduates is to joint in a weeklong Training of Trainers (TOT). TOT graduates will qualify to run IPM training sessions for other farmers.

- The TOT for Farmer IPM Trainers in Indonesian is heavily weighted on the side of leadership training. This also helps them as community IPM organizers. Leadership training includes facilitation skills, planning, and management. Farmers practice these skills in the TOT.
- Farmer IPM Trainers report that, while a five to seven day TOT provides them enough time to learn what is needed to conduct an FFS, they would like to have more training. In Indonesia, Farmer IPM Trainers Technical Workshops were instituted for the purpose of providing additional training when it is most needed, as Farmer IPM Trainers are conducting Field Schools. These workshops provide additional training in special topics activities. (Dilts and Pontius, no date)

All three farmers, Pak Murdjyo, Mbah Suko and Mbah Slamet were involved in all FFS/IPM training. They also kept on getting involved in many IPM related activities around and within their reach.

Involvement with National IPM Farmers Association (IPPHTI)

Pak Murdjiyo is a member of Ikatan Petani Pengendali Hama Terpadu Indonesia (IPPHTI) or the Indonesian IPM Farmers Association and is one of the co-founders of this national IPM farmer organization. "I was involved in the co-founding of IPPHT, because I took part in the initial national conference that gave birth to IPPHTI". He was in charge of materials presented at this national conference as a committee member from Moyudan. He is not interested in taking part in the management structure, as he is worried this position with take much of his time and will cause ineffectiveness and poor performance on his other work. He also noted that after the FAO/IPM program was phased out and the funding slowed down, that IPPHTI became increasingly unclear about their working programs. He mentioned that none of IPPHTI programs launched in July 2002 were executed at the time of this interview in November 2002.

Pak Murdjiyo further charges that this national organization is now loaded with personal interests and provincialism. Territorial projects were not distributed evenly; everyone in the leadership is fighting for their territorial benefits. They forgot that the IPM mission is not just to stay away from using chemicals in agricultural practices but to further optimize farmer's potential in handling their farming practices. The leadership of IPPHTI has created more division than harmony or union among their members. He said that Bantul region will not send representatives in the next national conference. Pak Murdjiyo will simply focus on his work dealing with farmers in his local area.

Mbah Suko, the Preserver of Heirloom Rice

Mbah Suko, much honored in his own land, helped educate a large segment of Javanese farming communities in the last decade of the twentieth century. His heroic efforts were focused on an alternative, organic form of agriculture. His two great achievements were (1) the preservation and use of 32 rare, nearly extinct varieties of rice and (2) the promulgation of combined rice cropping and fish farming. Both achievements were ways of avoiding toxic pollutions and both pointed to the bankruptcy of the “modern” BIMAS system of agriculture.

Mbah Suko is a 64 years old farmer who has two children and a wife. One of his children and his wife help him in farming activities. He lives in a small hamlet in the slope of Mount Merapi in Central Java. Mount Merapi is an active volcano, which from time to time spits lava and dusts and high heat gases to its surroundings. Mbah Suko is very lucky that his hamlet is never identified as one of dangerous areas of Mount Merapi eruption site.

Prior to farming he was a cattle trader for small animals like goats and sheep, now this is his side job. However, less profitable, he prefers farming to trading because farming gives him a peaceful life away from the city lights. He started farming in 1958, practicing traditional or indigenous agriculture like many other farmers in his neighborhood. He planted local rice, used compost to fertilize his rice plot and was able to subsist from his own farm with additional income from trade. Mbah Suko combined his rice farming with fish rearing. This combination of rice with fish farming practice proved to be very beneficial. The fish reared in the rice field eat the little insects and larvae of many damaging pests and in exchange, fish excretions provide good nutrition to the rice crop as it fertilizes the soil. Please follow on to Appendix C to learn more about rice farming combination with fish rearing.

BIMAS system versus Alternative Agriculture

Mbah Suko learned his farming skills from his parents, and started farming when he was twenty years old. Like other farmers at that time, he was using local seeds, applying compost or manure for fertilizer, and watering the field with traditional irrigation. In 1968 when the BIMAS program was introduced everything changed. He was instructed to plant high yielding variety of rice created by IRRI, use inorganic fertilizer, and apply pesticides to protect his rice fields from pest attacks. He did not like the changes imposed upon his traditional farming practices for he does not believe that the imposed practices of BIMAS will benefit him. Mbah Suko identified BIMAS program as harsh and insensitive to farmer's needs; as BIMAS was introduced with an iron-fisted approach and would not take "no" for an answer. BIMAS was a nationally controlled program down to the smallest farming communities living in the hamlets. He found that BIMAS program has the following disadvantages:

- High cost of farming inputs for imported seeds, inorganic fertilizers and creating unnecessary need for pesticides

- No guarantee for success, as he saw many of the BIMAS rice fields fail. There was a major blow to BIMAS way of farming in 1973 when a brown plant hopper (BPH) outbreak wiped out the Indonesian rice bowl area in the northern coastal area of Java. It was found later that indiscriminate spraying of pesticides kills everything in the rice fields; destroys ecological balance while some pests grow in their resistance to pesticides.
- BIMAS farming is damaging to the environment. Pesticides applied to crops flowed to rivers and other bodies of water. For him this simply means that he could not rear fish while growing his rice crop in the same field.
- BIMAS agriculture ridicules farmers who practice indigenous agriculture especially for using local seeds and applying compost to fertilize the soil. BIMAS instructed farmers to use inorganic fertilizers like *Urea* (manufactured Nitrogen fertilizer) and *TSP* fertilizer (Granular *Triple Superphosphate*) as something more convenient and easy to apply to their rice fields. Despite the high cost farmers have to bear, the

The BIMAS program ridiculed farmers using compost and manure as mistakenly impractical and dirty. But Mbah saw advantages in using compost in rice fields. He learned that compost and manure work well with local rice. Local or heirloom rice varieties are more responsive to compost, manure, and produce higher yields when compared to IRRI rice treated the same way. Farmers and consumers alike for their better taste and more aromatic flavors when compared to BIMAS or IRRI rice also prefer local rice varieties.

Mbah Suko illustrated the failure of BIMAS program when the whole village was instructed to plant BIMAS rice using BIMAS techniques, and the whole *hamparan*[23] were attacked by brown plant hopper, the virus and stem borer. Farmers cannot pay back their credit and they don't have money to plant the next crop. At that time they have to leave their rice fields unplanted. Farmers realize that they become dependent on foreign seeds, inorganic fertilizer and pesticides. And worse, the farmers felt they became a guinea pig of an unreliable government program.

Mbah Suko began to realize that this program is unfit for farmers when INSUS and SUPRA INSUS were promoted in 1980. At that time the Department of Agriculture introduced a new super seed of IRRI rice given as a credit package to farmers. Farmers must plant their rice-crops at the same time; all must simultaneously plant the same variety and apply the given chemicals which were inclusive the package. This package of using uniform approach contributed to the occurrence of outbreaks of brown plant hopper, that wiped out the whole *hamparan,* as pests began to develop natural resistances to pesticides. As a result of this major pest outbreak, farmers let their land lie fallow for some time as they didn't see any benefits of doing farming that way anymore. Soon after that farmers realized that by leaving their land unplanted (fallow) was not a good choice, because the government still required that they continue paying taxes on the land. If the farmer did not plant, he still had to pay property tax on the land.

[23] The term *hamparan* means a vast piece of rice-field to the edge of its natural borders such as forests, hills or man-made borders like villages and water reservoirs.

Preserving and Propagating Heirloom Rice

Mbah Suko did not learn about IPM until 1992. But already by 1987, Mbah Suko and other farmers began planting heirloom rice. They found that heirloom rice was resistant to various known rice pests, especially BPH and was able to produce good harvests. By planting heirloom rice farmers did not experience any more losses, and they were thereby rebelling against government policy. Some of the local or heirloom rice planted at that time was *Ketan Klutuk* (sticky rice) and *Rojo Lele, (one* of the highly preferred types of heirloom rice). Mbah Suko, a pioneer in the preservation effort of many heirloom varieties in his region in Central Java, won a national "Kehati Award" as "Preserver of the Environment" in the year of 2002. He received this award as national recognition for his diligent and tireless efforts in collecting and preserving 34 local heirloom rice varieties. This recognition made him the national leading farmer in preserving heirloom rice, which was suppressed and banned during the BIMAS/the Green Revolution period.

Please see Appendix E For a list of all the 34 heirloom rice varieties and its general characteristic Mbah Suko collected over 18 years, from circa 1987 through the present. During the strictly BIMAS program, the government banned cultivation of the least preferred heirloom rice only allowing a few types having the quality preferences determined by the GOI Department of Agriculture. Some local varieties that were allowed were *Rojolele, Krueng Acheh, Cianjur, Mamberamo and Cisadane*. These types of heirloom rice are native to the Indonesian Archipelago and have the preferred characteristics of government specifications, which, among others, are mainly responsiveness to nitrogen, BPH resistance, and short-term maturity[24].

Some of these varieties Mbah Suko quietly saved during the BIMAS period, some he actively collected when he got involved with the IPM program. His hard work brought him renowned as a pioneer in heirloom rice preservation and propagation. This tireless work was a work of love, as he was not paid by anybody. His only reward for the job has been the sense of satisfaction that he enjoys, knowing that he is helping nature by saving many rice germplasms that would have been lost by neglect of the world's many agricultural research institutions funded by Green Revolution programs. BIMAS or the Green Revolution only promotes a short list of rice varieties produced by the IRRI in Los Baños, the Philippines and the Indonesian Institute for Rice Research (IIRR) in Sukamandi, West Java, Indonesia.

Market selection will also determine whether heirloom varieties of rice will continue to be cultivated for very long. There won't be an incentive for farmers to plant the rice if there is no market response. It would be rather unfortunate if Mbah Suko's preservation efforts were wasted. There is a need for a consumer campaign encouraging people to buy more heirloom rice. Up to the time of my visit to Mbah Suko at the end of 2003, he told me that out of the 34 varieties at least half of them were surviving on the market. Consumer education is very crucial here; as consumers can be the major cause of pushing these "not so

[24] Most heirloom rice matures in 120 days. In contrast, the IRRI rice matures in 100 days. Maturity of rice crops depends on a number of factors; one of the factors that has significant influence to maturity is direct seeding that practices no transplanting. Direct seeding can cut maturity time by 10-15 days.

preferred heirloom varieties" to extinction. For farmers, a simple principle applies here: "I won't grow it, if you don't buy it"

As great was Mbah Suko's achievement in saving heirloom varieties of rice, his success as a proponent of combining rice-cropping with fish-rearing is almost as significant.

Mina-Padi, Rice-cropping Combined with Fish-rearing

Farmers realized that they had to free themselves from the depending on the usage of poisonous pesticides. They could instead, improve their farming revenues by practicing *mina-padi* or rice-fishery combination in their rice fields. These indigenous rice-fishery practices have proven very profitable to farmers whose rice fields are abundant with unpolluted water. Mbah Suko is the leader and strong promoter of using rice-fishery combination. He received at least 3 awards from District and Provincial Fishery Office recognizing his rice-fishery combination.

Mbah Suko made a list of homemade fertilizers that every farmer can make to improve soil nutrients and textures. Soil nutrients and textures improve the environment and provide good aeration around the root system of the plants. Good soil textures soften the soil structure and encourage the growth of beneficial microorganisms in the soil. All of these factors contribute to the best planting soil for any crop.

- Compost is simple to make and very important ingredient in indigenous or traditional farming activities. Compost can easily be made of wastes from the household, leaves collected from the yard, and the leftover biomass from rice fields. Compost should be treated as basic fertilizer, applied before the land preparation. Compost consists of complete nutrients needed by the crop. Compost also plays an important role in promoting natural microorganisms in the soil. Many of these organisms are beneficial to the plants.

- Liquid fertilizer made from leguminous tree leaves; becomes a significant supplier of nitrogen to the crops and can be home made cheaply. The material needed for this fertilizer is mainly the leaves that contain a high level NPK (Nitrogen-Phosphate-Potash).
- Manures or waste/excretion from livestock (cattle, goat) and poultry (chicken, duck) can be used to fortify compost and can speed up the decomposing process in making compost. Manure added to a compost bin, mixed with leaves, biomass, decomposer bacteria and some water to maintain compost moistures will produce high quality compost. The use of decomposing bacteria can shorten the time required for making composts to only 14 days. Regular compost needs about 3 months to get it ready.
- Fermented animal urines normally contain a very high concentration of nitrogen. The fermentation process will increase the dose and the strength of the nitrogen level. Application of fermented animal urine is usually done by using sprayer, and it is mixed with water in order to dilute the concentration to the optimum dose level best for the crops.

Mbah Suko also used some natural pesticides for the purpose of repelling pests and to cut-off the pests' life-cycle. He wanted to make sure that after applying these natural pesticides there won't be any pests. Predators are also killed unintentionally. For natural pesticides and repellents he uses a number of plant parts that have a bitter taste or are even poisonous. The three most common natural repellants are:

- *Gadung (Dioscorea hispida Dennst.)*[25] Commonly known as Wild yam, this tuberous wild plant belongs to the genus *Dioscorea* of *Opositae, sp.* It is known in Java and many other parts of the world for agricultural uses as well as for medicinal purposes. Wild Yam or *Gadung* has poisonous toxin called *dioscorine*, an ingredient capable of stunning or even killing pests and their enemies.
- *Mahoni* or Mahogany (*Swietenia macrophylla*) seeds could be used to expel pests like brown plant-hopper and it has the capacity to make them become barren. Natural pest control application should be done with the intent of killing the pests without killing their predators, the friends of the farmers guarding the rice fields from the pest attacks. They should be left alone and protected from farmers lethal practices.
- Using Marigold (*Tagetes sp.)* as a pest repellent is best when planting secondary crops in un-irrigated land. Marigold has a well-known quality for

[25] The toxicity has been attributed to an alkaloid known as dioscorine. The effect of such constituents is paralysis of the central nervous system. Fascinatingly, the yam possesses an insecticidal property as well. A study done by Banaag (1998) looks into the effect of the *D. hispida* against diamond back moth which happened to be an agricultural problem. Source: http://www.arcbc.org/arcbcweb/ASEAN_Precious_plants/medicinal/Dioscorea_hispida.htm, downloaded 03/20/2004.

repelling various pests. Farmers who plant Marigold along the sides' rows of their chili crops (*Capsicum frutescens*) will save their crop from damaging pests' attacks. Marigold is also known for repelling caterpillars, and other pest larvae.

Mbah Suko does not use or apply any natural pesticides made out of non-pathogenic fungi. He did not see a need for that. He explains various ways to make natural fertilizers, organic pesticides and running spider farms.

Mbah Suko mentioned the significant benefits and increasing profit from alternative agriculture. He stated that alternative agriculture contributes to effectively producing healthy food for the farmer's family and for the consumers who buy produce from the farmers practicing alternative agriculture. Alternative agriculture produces healthy food simply because it does not apply agricultural inputs containing chemicals. He also stated that alternative agricultural practices cuts down production costs and improves the selling prices. Alternative agriculture produce can sell at higher prices because it is not regulated by the government-pricing standard.

Farmers practicing alternative agriculture will maintain good fertility in their soil. This brings long-term benefits to farmers' agricultural activities. Mbah Suko noted that some farmers believe that practicing alternative agriculture is difficult though in fact it is not, because alternative agriculture uses resources that are readily available from the surrounding area, from the wild, or that can be purchased at an affordable price. Mbah Suko challenged the farmers who viewed alternative agriculture as an under-achieving system to compare the tonnage of yields of alternative farming and BIMAS farming. He suggested that farmers should make complete input/output analyses when they compare costs against profits. It is true that yields for farmers practicing alternative agriculture, could be lower than when they use conventional agricultural methods under the BIMAS program. Nevertheless, alternative agriculture produce sells at a price of 30-50% higher at markets. While yields are lower than those produced by conventional methods, farmers and consumers look at many other tangible benefits, like consuming healthy food, creating a healthy environment that is safe for farmers and their families as well as for their animals. These benefits are priceless.

In order to produce one quintal or 100 kilograms of compost fertilizer, a farmer would have to pay around ID Rp. 30,000.00. This is equivalent to about US $ 3.00. It is true that farmers have to spend more on labor when using compost, but the difference in labor is insignificant when compared to the cost of buying chemical fertilizers. The only difference between the two is that farmers can easily purchase inorganic fertilizer in the open market and have it ready to use whenever they need it. This is precisely the advantage that enticed many farmers to go for the BIMAS program, a program that make them easy in doing farming but carry the high price in social cost of health and environmental degradation.

Alternative agriculture in Indonesia is based on (1) the use of local seeds, enhanced with compost and green fertilizers, made out of leaves, and (2) the application of appropriate, non toxic, organic pest controls and materials. This alternative practice results in high production, or, at least, the same yields-level as the heavily chemical-dependent BIMAS system of agriculture. Mbah Suko estimated an average of 4 quintals of dry unshelled rice per 1,000 meters square for farms using either system of agriculture. The cost comparison of inputs applied to a 1,000-meter square plot favors his system of alternative agriculture. Mbah Suko's alternative system would cost farmer an average of only ID Rp 60,000.00, whereas BIMAS would burden the farmer with a sum of ID Rp 125,000.00. The costs-benefit comparison points up the much lower cost of production for alternative farmers – who also rake in higher revenues from the higher market value of healthy rice along with their altemative agriculture. In addition, if this is done with the combination rice cropping and fish rearing (described in the following section), then the profits farmers could enjoy are phenomenal.

In 2001 Mbah Suko claimed that he had never really made use of any chemical pesticides. However, farmers outside of his group were still using the BIMAS approach, especially in planting brown plant-hopper (BPH) resistant rice varieties. Suko stated that if farmers were forced to commit themselves again to the BIMAS system of agriculture, he would resist. For him making BIMAS compulsory would be the equivalent to launching a second phase of the Green Revolution. It would make farmers dependent on the big corporations and their manufactured products and render a livelihood in farming unsustainable.

The historical irony is clear: the old organic system of agriculture is more modern than the new (BIMAS) system. Now called "alternative", it had existed for centuries as "traditional" agriculture. The new progressive system is actually a variant of the old traditional system, a system that never needed inorganic fertilizers or manufactured pesticides.

We must now turn to mbah Suko's second great alternative system: combining fish farming with rice cropping.

Mina-Padi a Mutually Beneficial Ecosystem

The Mina-Padi farming system of combining rice-cropping with fish-rearing is based on the fact that the rice crop environment with plenty of water can be a perfect environment benefiting the growth of the fish raised in the rice field. These are the main features of the system:

- Using traditional land preparation techniques, farmers make the field ready for traditional rice cropping. Using draft animals for land preparation is preferable to using a hand-tractor. This way it is guaranteed there will not be any oil spill in the rice field.
- Grow heirloom or local rice that will grow well without using inorganic fertilizer. In addition, local rice does not need application of chemical pesticides.
- The farmer must irrigate the rice field so there is enough water for rearing the fish, and he must make sure no pollutant gets in to this pool.
- Newly hatched fish may now be put in this flooded rice field. From this point on, no chemicals, application can be allowed, especially from the

neighboring field, as pollutant in rice because it will poison the fish. Mina-padi farmers need to talk their plan with neighbors so no poisoning accident will happen.

- The rice crop will create a good environment for fish rearing. Insects around the rice crop, their larvae and some algae, and small grass will become good sources for fish food. No chemical application will guarantee the balance or equilibrium of the ecosystem necessary for fish rearing and rice crops alike.
- Excretions of the fish become good nutrients for the rice crops; the fish eat the bad insects and consume insect larvae around the crop root system. What happens with mina padi farming or RCCFR, is that farmers create a mutually beneficial relationship between their rice crops and the fish they raise. These way farmers can save and lower their cost of the production and, most important, they can become independent of externally supplied agricultural inputs.

Mina padi farming could easily double farmers' revenues. Some revenue comes from the rice harvest and other revenue comes from the fish harvest. In a simple balance sheet, Mbah Suko showed the cost-benefit calculation of 1,000-meter squares of a mina padi plot planted with heirloom rice and reared with Asian carp. Table 6 below explains why the *mina-padi* system doubles the farmer's revenues. These double revenues generated from both the sales of rice and the total sales of fish, the fish are harvested three times during three different stages of growth i.e. fry size, fingerling size, and consumable size. The *mina-padi* farmer also enjoys some fish for home consumption, another tangible benefit that was not calculated in the spreadsheet. Please see table 6 in the next page to see the costs-benefit calculation of fish-rice farming combination made by Mbah Suko.

Table 6: Costs/Benefits Calculation of Mina-Padi per 1,000 square meters plot

			Expenditures	Revenues
Rice cropping				
Straw clearing from field	6 man/day @ Rp5,000		Rp30,000.00	
Seed bed preparation	1 man/day @ Rp5,000		Rp5,000.00	
Fix borders/Dikes	4 man/day @ Rp5,000		Rp20,000.00	
Heirloom Seed (Rojolele, Berlian)	5 Kgs @ Rp3,000		Rp15,000.00	
Manure	20 bushels @ Rp2,000		Rp40,000.00	
Natural pesticides	2 liters @ Rp5,000		Rp10,000.00	
Plowing	2 times @ Rp10,000		Rp20,000.00	
Harrowing	2 times @ Rp10,000		Rp20,000.00	
Transplanting	10 people @ Rp1,500		Rp15,000.00	
Weeding	2 times @ 10 people @ Rp1,500		Rp30,000.00	
Land tenure/rent	6 months		Rp300,000.00	
Other costs	food for laborers		Rp50,000.00	
additional manure	for second application		Rp25,000.00	
Total cost			Rp580,000.00	
Total harvest	450	kgs		
Harvester/worker share 1/8 of total harvest as payment	56.25	kgs		
Selling price	Rp2,500.00	/Kg		Rp984,375.00
Profits from rice-cropping				**Rp404,375.00**

Continued in the next page

Table 6 continue

Fish Rearing			
Breeder Fish	10 heads @ Rp10,000	Rp100,000.00	
Fodder (rice bran)	10 kgs @ Rp1,000	Rp10,000.00	
First harvest at fry size 1-2 cm	15 cups @ Rp150,000		Rp150,000.00
Second harvest at Fingerling size 5-7 cm	10 kgs @ Rp25,000		Rp250,000.00
Third harvest at consumption size 15-20 cm	15 Kgs @ Rp15,000		Rp225,000.00
Total costs		Rp110,000.00	
Total Sales from Fish			Rp625,000.00
Profits from Fish-rearing			**Rp515,000.00**
Percentage of fish over rice increase			**127%**
Total profits			**Rp919,375.00**

From the above spreadsheet calculation, Mbah Suko showed that Mina-padi farming practices bring farmers more than double the revenues of income that fish rearing brings. Farmers could easily take home about 127% additional incomes. In addition, the farmer's family enjoys some bonus nutrients from some of the fish they eat. On top of this financial benefit, there are some other tangible benefits such as better health and an improved environment for their families and the surrounding communities.

Mbah Suko has also done research on interrelationship among the jumping spider, the brown plant hopper (BPH), and the rice seed bug (RSB). From his observation, he found that a jumping spider can easily consume about 10-15 BPH and RSB in one day, depending on their body size. After an extensive observation, he concluded that jumping spiders, a good spider population in his rice field, would guard the rice field from damaging bugs that attack the rice crops. Therefore, he decided to increase the jumping spider population through raising this spider species in his spider farm. This simple process of mating male and female spiders in a fish aquarium and feeding them regularly with bugs he collected from the rice fields. After some time, the female spider will lay eggs, and when the eggs hatch, he keeps them for some time and feeds them small insects. When their size is good enough to survive on their own, he releases them in his rice field. This way his rice crops never suffer any BPH or RSB attacks.

Mbah Suko also believes that there should be ongoing efforts to improve alternative agriculture; for example, he uses bacteria taken from the cow rumens in making better compost faster, and more complete with nutrients. This technique enhances decomposing process and encourages the growth of good microorganisms for better and healthier crops.

The Ani-ani Harvester for Heirloom Rice

The cultivation of heirloom rice makes a positive contribution to the social behavior of farming communities, because of the way it is harvested. The long panicle stem and the long plant posture of heirloom rice has revived the use of *ani-ani* as the tool for harvest. *Ani-ani* is a small hand-held knife protruding out of its seat located perpendicular to the short bamboo handle that could easily fit in the palm of the person who is harvesting. *Ani-ani* harvester use was lost with the introduction of dwarf IRRI rice by BIMAS, which requires a serrated-sickle knife with a short handle to harvest the rice. The dwarf IRRI rice has short or no panicles that make it impossible to harvest with *ani-ani*. With the phasing out of *ani-ani*, the social practice of traditional rice harvesting was also gone.

Harvesting with *ani-ani* requires many people to work and harvest the rice field. In farming communities in Central-Java, especially in the village where Mbah Suko is from, people who help harvest the rice crop take one-eighth of the amount they harvest as payment of their harvesting work. Harvesters may come by open invitation or by selected invitation. With selected invitation, normally only friends and close neighbors are invited to the harvesting. Farmers choose selected invitation because the field to be harvested is usually small or the owner wants to return favors to friends who invited them to their harvestings. Harvesting activities in the indigenous farming practices was a social event where community members come together to celebrate the joy of harvest. And people, who participated in this traditional harvesting, bring home the fruit of joy from the crop owner. This sharing of harvest strengthens the social fabric and caring between members of the traditional farming communities. Mbah Suko points out that BIMAS farming practices wiped out many of the good social values of these indigenous farming communities that were commonly practiced in the past in his village. They are now being replaced with capitalistic individualism. Farmers who cultivated dwarf IRRI rice will simply sell to a wholesale buyer at the farm-gate, and this buyer will take care of the harvesting process as well as make sure that every single grain is taken away from the field sold to them. The end result was the loss of indigenous harvesting practices related to heirloom rice cropping centering on the use of the ani-ani harvester. The technological shift led to a shift in their social values as well.

Mbah Suko blamed the government for imposing over four decades of BIMAS' iron-fisted practices. BIMAS was responsible for so many losses paid by the farming communities in Indonesia. Farmers suffered from the following unexpected losses:

- BIMAS banned most of farmers' indigenous practices in land preparation, seed selection, in fertilizing their soil, in pest control, and even in determining the market sale price. BIMAS controlled the market price by setting the ceiling price during *pacelik*[26] and the bottom price during harvests season.
- BIMAS caused much loss of farmers' indigenous or traditional knowledge learned from their parents and grandparents;
- BIMAS caused the loss of many social structures in the farming communities.
- BIMAS killed the spirits of *gotong-royong* or cooperation among members of the community to accomplish individual or communal projects. *Gotong-royong* was traditional practices existing in many Indonesian farming communities. This spontaneous work-sharing cooperation among members in the community sustained the social fabric. People used to help one another and aided others in need. Now this spirit of *gotong-royong* has ceased to exist. People now care only for themselves and their own families.

[26] food scarcity period in between harvest seasons

- BIMAS caused the loss of almost all of the heirloom/local rice varieties as well as other local food crops. The government at the time of BIMAS banned cultivation of heirloom seeds.

In his mind, Mbah Suko rejected BIMAS right from its inception, but he did not express his refusal openly because he feared the merciless repression of the Suharto regime. Mbah Suko quietly did what he could without attracting the official scrutiny.

During his extensive interviews with me, Mbah Suko explained how the BIMAS agricultural system did so much environmental damage. The application of excessive fertilizer made the soil hard and cracked when dry. Indiscriminate and massive application of pesticides BIMAS program caused a broken link in the food chain and disturbance to ecological equilibrium. For example, the decimation of the population of owls and rice-field snakes and a result of pesticides and the reduction size of their habitat led to an uncontrollable number of mice. Owls and snakes are enemies of rice-field mice. Another significant impact of the generous application of pesticides is that the food and produce are tainted with an unsafe level of poison from the pesticides.

Getting Involved in the IPM Experiences

1992 was the year when Mbah Suko first learned about the IPM and in the same year he joined the IPM. At that time, two IPM models were offered; namely the model that was formed and sponsored by the government with the support of BAPENAS (Agency for National Planning) and the self-supporting model in cooperation with Non-governmental Organization (NGO). He took part in an IPM sponsored by an NGO in March that same year.

Mbah Suko immediately saw the difference between the IPM approaches and the BIMAS approaches. In BIMAS, the government stressed the achievement of the highest production by optimizing means of production. This meant the heavy use of chemicals. The government orchestrated same-time planting and involuntary participation of all members of the farming community in their program. To enforce its policy the government threatened anyone who refused to participate. Thus, rebellious farmers could have their ID cards marked with BTI, which stands for Barisan Tani Indonesia, a communist associated farmer's organization. This threat was probably just a bluff: a rumor purposely released by the government officials to deter any opposition to the BIMAS program. In the political atmosphere of that time most Indonesians were afraid to have their names associated with any communist party affiliation. The government found this oppressive method to be very effective for silencing those who would have opposed the BIMAS program.

In the IPM program, either in the version sponsored or managed by the agricultural service or in the version stressing self-support in cooperation with an NGO, the approach was very liberal. The only differences between government-sponsored IPM training and the training that was in cooperation with an NGO, was that the government IPM training program limited the number of participants to 20-25 people and required training sessions end at the end of work days (around 3:00 PM). The NGO version of IPM training accepted any interested farmers and allowed their sessions to continue into the evening. They also allowed the meeting to take place in one of the farmers' houses.

Mbah Suko was sympathetic to the IPM program, though in the beginning he thought that IPM was merely an agricultural program designed to replace BIMAS. He soon realized that what attracted him and many other farmers to IPM program were their curiosity, the opportunity to learn, and their need to know what problems they were facing and how to overcome them. IPM program was carried on with the purpose of helping farmers be fully aware of the new farming practices from the start to the end. IPM wanted to help farmers understand what was really going on in their rice fields. IPM program helped farmers to calculate the cost, estimate their yield, and learn the value of produce they sold. In contrast with BIMAS, the IPM approach was mainly focused on maximizing production of rice while preserving the farmers' health and quality of life.

Being an IPM Trainer

By 1995, Mbah Suko had become a farmer trainer. However, he claimes this role was unofficial as he would be available on demand. He had no official position as a farmer trainer, but he said he was well recognized around the area among the group of the farmer officials working in the Agricultural Services. He also works among the students and the academic community. During the year, 2001 he was invited approximately 60 times to carry out training and seminars. He has always carried out the IPM training voluntarily, although sometimes he was paid. Mbah Suko is always happy to help other farmer from outside of his local area to improve themselves in their farming practices. His altruistic motive is based on his intention to help improve the broken agricultural system that has become a serious problem.

In the context of spreading the system of IPM and alternative agriculture Mbah Suko brought training to many places and groups: high school students, university students, farmers, and some government officials from the Department of Agriculture. His seminars have involved people from various social classes. Along with training sessions, he likes to join in a *tukar-kawruh* or exchange ideas and experiences activity. Mbah Suko encourages the dissemination of information using *getok-tular* or word of mouth among the farmer in the villages. He welcomes farmers, students, and anyone who visits him in the house, sometimes just for chatting. By 1995, he had become an important educational leader.

Mbah Suko is often invited to carry out IPM training, which is usually sponsored by the provincial, district of the sub district office of the Department of Agriculture and Fishery. Sometimes farmers from other villages invite him to come and speak. So do student groups. Mbah Suko believes that he has been invited as either as a speaker or as a trainer because people see him practicing what he preaches. For his tireless efforts in promoting IPM and ecological friendly agriculture Mbah Suko has also caught the attention of the mass media as the subject articles in several newspapers. His efforts in promoting *Mina-padi* or rice-crop combined with fishery system received recognition from provincial and district Departments of Fishery. His living room is decorated with the many awards he has received.

Mbah Suko asserts that much of what he shares with the farming communities he learned from the practices of his parents and from the wisdom of his ancestors. In addition, by socializing with some theorists, he came to understand the theoretical base of his own practices. He believes that *mina-padi* is an original concept of indigenous practice. This farming practice will significantly increase the income of the farmers' families in his local area. In his own career, he has achieved a synthesis of the science of IPM and the no less scientific wisdom of traditional practices.

Mbah Suko did his own research for an extensive time before spreading and disseminating his findings. He did an extensive study on compost application compared with inorganic fertilizers. He found that the common assumption that using compost will lower rice crops yields is not true. His study proved that using compost to fertilize the soil is as good as using inorganic fertilizers. Through this research, he can show that rice-cropping with compost in 1000 meter squares plot produces 4 quintals of dry grain rice; rice cropping applied with inorganic fertilizers also produces 4 quintals of dry grain rice. Both results, in term of yields produced, obviously do not have a significant difference; while compost application brings more extra benefits like building better soil structures and ecology, making soil texture soft and aerated, and emits no pollutants to the environment. In addition, the larger financial benefits farmers can enjoy with compost cost much less to the farmers' pocket. The same principles also apply to his experiments with jumping spiders. After finding that the increasing number of jumping spider population in the rice field improves the protection to the rice crops, Mbah Suko then develops methods for propagating jumping spiders by raising them in his spider farm so he can have a good supply of spiders for release among the rice fields. After proving the validity of his experiments, Mbah Suko then shares his findings with fellow farmers – who have confirmed his experiments. Only after this peer sharing of experiences with his fellow farmers, does Mbah Suko disseminates his research findings to broader audiences of farming communities

Mbah Suko strongly believes that alternative agricultural technologies and practices are too important to neglect. Farmers with limited resources will find that alternative agriculture is the most affordable, as it uses resources readily available from their surroundings. Alternative agriculture does not make farmers dependent on artificial fertilizers and on the chemical companies that sell their products at high prices. He would like to see the government play an active role in promoting healthy food through consumers' education. This way farmers can enjoy the benefits of selling their produce to an educated group of consumers. He also suggests that government start making passing laws to protect farmers' innovations so that their findings are not stolen by individual or companies that will make a profit out it.

Sharing and Disseminating IPM concepts

Mbah Suko is a very popular farmer trainer in IPM and alternative agriculture. In the year 2001 alone, he was invited to speak or run a training 60 times. That is an average of more than one in a week. He has been generous with his time in sharing and disseminating the IPM and alternative agriculture ideas. He travels outside his village, his sub-district, and district and even outside of his province of Central Java. He traveled to Boyolali, Madiun, Yogyakarta, Bandung, Semarang and Ambarawa. He remembers in particular a group of farmers from Kebumen who had heard about him from another friend, came, made a visit to his house, and invited him to explain IPM ideas and to share his alternative agricultural practices. These farmers live about 200 kilometers away.

Mbah Suko has also received frequent invitations to speak in the academic community. Among those are the state universities from Yogyakarta, Semarang and a private University of Muhamadiyah and one Islamic boarding school (pondok pesantren). He trained and shared his IPM knowledge and experiences on IPM to at least two groups of women farmers. One group was in Magelang and another was in Kebumen. In addition, he also trained a mixed group of men and women farmers. He found that female farmers are more responsive then their male counterparts. He also found that women accept the IPM approaches more readily than their male partners as they believe that IPM optimizes resources from their surroundings and that it boosts their agricultural production – in contrast to the practices suggested by BIMAS program. The BIMAS philosophy is basically the opposite: if farmers want to achieve higher yields they should be ready to invest more. These agricultural inputs are often expensive.

Female farmers were excited to learn about IPM because IPM touches issues related to home economy. Women farmers are interested in lowering down the cost of farming production. Mbah Suko pointed out the important role women have traditionally played in Indonesian agriculture. Male farmers prepare the land; female farmers do the rest, right on through to serving the food on the table. The following list describes the allocation of work between men and women in the household of typical family farm.

In rice-farming households female farmers have traditionally been in charge of the following tasks:

- Seed planting
- Transplanting
- Weeding
- Harvesting
- Storing
- Drying
- The whole food processing of the grain to make ready for cooking
- Cooking
- Serving the food on the table for the family

The male farmers are mainly in charge of:

- Land or soil preparation, this includes mending the border dikes and repairs to irrigation canals
- Seed-bed preparation
- Seed planting
- Irrigating
- Weeding

- Harvesting
- Storing
- Transporting the grains from the field to the house for drying and then to *lumbung* or storage.

From the list above we can see there is some work being shared between the female and male farmers like seed planting, weeding, harvesting, and storing. Mbah Suko also noted that women farmers are more punctual and show better self-discipline compared to their male counterparts. He doesn't blame the male farmers who come late to his training session as he understands that many of them come from other jobs so they can have additional income.

Involvement in Farmers' Science Meeting

Mbah Suko has noted that he had played an active role in the Temukarya *Sains Petani* or the Farmers' Science Meeting. As a farmer trainer, he was always invited. A high point in this activity came in Cibubur, a town near Jakarta, in 2001, when the Farmers Science Meeting invited him to speak as a resource person. At this meeting, he presided over a discussion about adopting alternative agriculture.

As a farmer's trainer, he was often asked to respond to specific questions from farmers. In answering their questions, Mbah Suko has not hesitated to show his fellow farmers how to do it right in the rice field. He supported the idea of having regular *Temukarya Sains Petani* seminars. This way farmers could meet and discuss issues and problems they encounter in their farming activities; and also share any solution they might have found. Such meetings normally got the attention of the press, thus making a wider range of people aware of the issues they discussed in the meeting.

In 2001 at the national meeting in Cibubur he discussed various issues. First, he noted the problem of the government policy that causes sufferings of the farmer. Second, he presented his idea of practicing alternative agriculture combined with fish rearing. Third, he discussed issues about the difficulties of land use to the farmers; what role government could play to help the farmers. He pointed out that most farmers own very small pieces of land to cultivate the crops in order to support their family, but as more land changed its function away from agriculture; such small farmers faced a major problem. At the same time, the government had created an agricultural policy that that leads to the worsening quality of the existing land. Pointing to programs like BIMAS, he noted that inorganic fertilizers and chemical pesticides produce more damage to the soil. Farmers who follow the BIMAS system have been damaging the quality of their soil. Mbah Suko took part in the national seminar only once; but he attended many provincial level meetings. In these meeting, he has always emphasized the importance of farmers being autonomous and not allowing themselves to depend on outsiders. In these opportunities, he explained the benefits of promoting the pests' natural enemies, and of using bacteria to speed up compost making. He was continually promoting the idea of *mina-padi* as the best way to promote IPM, while at the same time doubling farming profits.

Involvement with National IPM Farmers' Association (IPPHTI)

Mbah Suko did not get involved in founding the National IPM Farmers' Association (IPPHTI). In retrospect, that was a good move. For although IPPHTI represented the farmers' implementation of IPM, its leaders were disengaged from the communities they are supposed to serve – with advice and small grants. They did not succeed in promoting the goals of the original IPM and sustaining IPM as a viable program. He did not receive a formal invitation to this 1999 national meeting in Moyudan, Central Java, but he went anyway. This meeting gave birth to IPPHTI, but Mbah Suko could not be called a co-founder. Probably his name was not in the list, because he came to IPM circle via the NGO promotion, rather than via the FAO or Department of Agriculture. But, he decided to come along to this national meeting in Moyudan, Central Java, because he knew that he would meet many of his fellow farmers coming from different areas of Indonesia. He observed that IPPHTI promoted the concepts of IPM farming that ecologically co-exists with nature, but he disagreed with two of their stands. First, they allowed the use of inorganic fertilizers; and, second, they allowed the use of narrow-spectrum chemical pesticides. This showed that they maintained the original idea of IPM when it was introduced to farmers during the IPM inception periods, but disrespected the later trends of many IPM farmers that had already moved toward organic agriculture by abandoning all the manufactured agricultural inputs, i.e.: pesticides and inorganic fertilizers .

Mbah Suko believes that IPPHTI should change their position in such important issues. Allowing all those manufactured products on IPM-farms that were trying to go completely organic, is very antagonistic to their own mission. He also criticized the IPPHTI I for emphasizing more theoretical ideas, and not supporting practices which are much more needed by the farming communities. He also criticized IPPHTI for not defending farmers from reintroduction of conventional practices by chemical corporations. For Mbah Suko, the destructive outcome of IPPHTI stance would be to make farmers once again dependent upon outside means of production. So he strongly suggested that IPPHTI move decisively in the direction of organic agriculture and away from the old manufactured fertilizers and chemical pesticides.

Mbah Slamet, from Animal Health to IPM

Mbah Slamet is another progressive farmer whose agricultural life experiences illuminate the educational and scientific issues by the introduction of IPM.

Born in 1939 in Bantul, Central Java, Indonesia, Mbah Slamet was 65 years old at the time of the interview. He has a family of five; three children and a wife. Up to December 1995 he worked at Division of Animal Husbandry, Department of Agriculture as a veterinary assistant. He then retired from this position and became a full time farmer. When he was still active as a civil servant working as assistant veterinary he did not farm at all. He gave four reasons why he finally decided to become a farmer after his retirement:

- After retirement he found no other activity around the house
- All his neighbors were small scale, subsistence farmers
- They raised some poultry and livestock like cattle and goats to make additional income for their family
- When the IPM program was introduced in his area in 1990, he joined in the program and took part the IPM training

He saw at that time there were some changes happening. Most notably, farmers were becoming more autonomous then they used to be. Farmers used to listen meekly when the bureaucrat talked down to them and told them what to do in their fields. Now farmers could determine for themselves what crop they deemed appropriate to cultivate, how they would do their farming activities, and they felt free to meet with other people having similar ideas.

Mbah Slamet never practiced traditional farming. When the government launched the BIMAS program he agreed with the program, believing that BIMAS would improve farmers' food production and that the government intended to better farmers' livelihood. In 1985 he saw that the country had achieved self-sufficiency in food production and believed that this achievement was the result of the BIMAS program, which is the Indonesian version of the Green Revolution. Then afterwards he realized that BIMAS had created many problems.

Mbah Slamet joined in an IPM Field School in 1990; he learned the BIMAS model of agriculture created environmental damage and made farmers become dependent on the outside resources for their agricultural inputs.

After the IPM field school training, Mbah Slamet became more involved in the IPM program activities. In 1991 he began to practice alternative agriculture and focused on using organic material in his farming activities.

Mbah Slamet tried his best in adopting the IPM farming practice along with alternative agriculture, and his approach may be summarized in the following eight practices:

- He cultivated some of the most popular heirloom/local varieties of rice like *mentik wangi, pandan wangi* and *rojolele*.
- He applied IPM principles in his farming activities, i.e., grow healthy crops, observe regularly, conserve natural enemies, and the farmer becomes the expert in farming.
- He gradually switched to alternative agriculture. He applied compost and manure but mixed with some inorganic fertilizers. He wanted to improve his soil condition, but was still afraid that if he made a complete switch he would suffer some losses.
- He made use of the ancestral knowledge of *pranoto mongso*, the ancient farming almanac. The principle of *pranoto mongso* suggests the farmers observe the changes of climate and the weather pattern in order to determine the appropriate crop for planting. For example *mongso ketiga* (the third season or dry season) will be suitable for planting crops requiring less water.
- He used a biological agent made out of *Beuvaria bassiana (Bb)* to control *walang sangit* or rice seed bugs. *Beuvaria bassiana* fungus can kill rice

seed bugs by growing in between segments of their body. After several days, rice seed bugs contaminated with Bb grows a moldy layer around their body and die. Rice seed bugs destroyed by Bb contamination can be collected and used for rice seed bugs control again. Bb is also proven effective to control brown plant-hopper.

- He practiced *tabela* or direct seeding which means direct planting of seeds to the rice field without using a seed bed or transplanting process. Some research shows that direct seeding speeds up rice crop maturity 10-15 days faster. With direct seeding, the plants do not need to grow the second layer of roots as would normally happen with the transplanting method. *Tabela* planting means that the planting operator normally uses a pre-measured square-guide to drop the seed in the proper place. This way distances between plants in the rice crop are well aligned.
- He made liquid fertilizer from leaves of leguminous trees, which are rich in nitrogen such as *dadap serep* (*Erythrina subumbrans*), *ketelo* or *Manioc suculenta* also known as Cassava, *Lamtoro gung* (*Leucaena leucochepalla*), *Gliricidia sepium* or Mexican lilacs. Mixing these leaves with cattle urine will increase the nitrogen content of the mixes. Fermented cattle urine is processed by letting it ferment in a large container for a couple days. After being diluted, this preparation is then ready to be applied. Application can be done using sprayer. Both the leguminous leaves and fermented cattle urine are good home-made liquid

fertilizer. Mbah Slamet thin this solution with water, this mix of liquid fertilizer was then applied using a hand-pump sprayer applicator.

- He used various aromatic tubers like *tumeric, ginger roots, galangga* to expel pests and the bitter and poisonous tuber such as *gadung* (wild yam) to stun or even kill them. All the materials were pounded or grated, this mix is then left for about three days. After filtering, this preparation could be used by applying it using sprayer. Appendix C will describe some detail about making this preparation and recommended dose for application.

There have been other alternatives to BIMAS or Green Revolution agricultural systems. The IPM and organic agriculture are two main possibilities in alternative agriculture (AA), Mbah Slamet is convinced that the alternative agricultural model benefits farmers in a number of ways:

1. AA reduces farming production costs because farmers do not have to buy expensive inorganic fertilizer or manufactured chemical pesticides.
2. Farmers can maximize available materials around their home, such as household waste, fallen leaves, and straw from the fields to make compost they can use to increase production.
3. Farmers are engaged in farming without damaging the environment.
4. The farm products produced this way are healthier, and farmers enjoy a higher selling price.
5. He found that the yield harvested by farmers using AA was equal to the yields using BIMAS methods.

Comparing the Costs of Production of Both Systems

Alternative agriculture has benefits that are economical as well as environmental and social. For example, it costs farmers only about ID Rp 1,600.00 -- with exchange value at the time 1 US dollar = ID Rp 10,000 – it is approximately 16 cents of US dollars to produce one liter of homemade liquid fertilizers. Ingredients to make this are mainly leguminous tree leaves and cattle urine, both is high in nitrogen content. Nevertheless, if farmers were to purchase one liter of manufactured liquid fertilizer from an agricultural kiosk, they have to pay at least ID Rp 17,500.00 (approximately 1.75 US dollars). Thus farmers could save roughly ID Rp 15,900.00 (approximately 1.59 US dollars) of every liter use of home-made liquid fertilizers.

In the case of compost making, it would cost the farmers about ID Rp 300 per kilogram. The total compost needed to cover 1,000 square meter of rice field is about 1.5 – 2 quintal of compost. It cost the farmers ID Rp. 300.00 per Kg in compost production, so the total cost a farmer pays about ID Rp. 45,000.00 to ID Rp. 60, 000.00 per thousand square meters. If farmers choose to apply inorganic fertilizers, they will need 25 kg of Urea at ID Rp 1,400.00 per Kg, 10 kg of TSP at ID Rp. 1,500.00 and 10 kg ZA (ammonium sulfate) at ID Rp. 1,400.00. This brings a total price tag of ID Rp. 64,000.00 for chemical inputs to cover the similar area. It is apparent that farmers could save up to ID Rp. 19,000.00. While the cost of pesticides for farmers practicing the IPM is insignificant, farmers who apply the BIMAS principles would have to add the cost of a liter of pesticide, at the high retail price of ID Rp. 20,000.00 per bottle. Farmers could realize total cost savings on fertilizers and pesticides, up to ID Rp. 55,000.00 per 1,000 meters square of rice field.

Farmers' benefits extend beyond financial when practicing AA. Farmers do not poison their agricultural products, themselves and their families. They do not pollute their living environment. Compost, for example, will stay in effect in the soil for about 9 months before it needs reapplication. Compost also softens the soil, as bacteria and organic matters in compost produces air and other nutrients beneficial to the plants. Contrast to inorganic fertilizers, they need to be applied at least 3 times during the cropping season and it hardens the soil. Inorganic fertilizers coagulate the soil particles and push away air particles from the soil. This process practically suffocates the crops, as it makes harder for plants to breathe.

Mbah Slamet produces liquid fertilizer that he sells for ID Rp. 3,000.00 (equal to about 30 cents in US Dollars) per 600 ml. Farmers have to pay approximately ID Rp. 17,500.00 (about US $ 1.75), which is the kiosk retail price for one liter of comparable, factory-made liquid fertilizer. A savings of more than 70% to the farmer occurs if they buy homemade liquid fertilizer made of mixed leguminous leaves and cattle urine. It costs cheaper to the farmers if they are willing to spend some times making those fertilizers themselves.

Mbah Slamet believes that the alternative model of agriculture is the best, especially if one uses a combination of organic fertilizers and natural or bio pesticides. This approach can lower the cost of production significantly, without losing productive capacity. To Mbah Slamet, alternative agriculture combines the optimum results, which includes a few good bonuses like higher selling prices and healthier environments for the farmers and their communities. He has a negative view of the BIMAS agricultural model, noting the following issues:

- BIMAS produces a generation of farmers that is dependent on outside resources, a situation that causes environmental damage and relies on a high cost of production; BIMAS misleads them into thinking that they are doing the best by using BIMAS agricultural methods.
- BIMAS has caused the loss of many traditional farming practices. These older practices accorded well with nature and were friendly to the environment.
- BIMAS caused the disappearance of many of heirloom rice varieties by prioritizing IRRI varieties and instructed farmers to follow orders in planting IRRI rice varieties, despite farmers' hesitation and disagreement.
- BIMAS caused deterioration of some socio-cultural customs of traditional communities. He pointed that BIMAS practices causes the loss of *gotong-royong*, the communal value of helping one another in a joint communal activities. BIMAS promotes individualism among members of traditional farming communities through emphasizing the values of increasing individual farming production.

Mbah Slamet indicated that not the entire BIMAS system destructive, but in particular it created bad environmental impacts. If BIMAS model of agriculture were to be carried out as a national program, he would object. He believes that both his own observations and the research of scientific experts show that BIMAS damaged the soil and arbitrarily killed pests' enemies, which help maintain natural ecological balance.

Mbah Slamet still uses of urea (nitrogen) fertilizer; he applies 8 kg of urea in 1,000 meter square of his rice field as supplement to compost and homemade liquid fertilizer. This is the only part of BIMAS practice he still follows, but he is gradually moving away from this practice as well. He explains his continued use of urea, by asserting that the land still very much dependent on chemical fertilizer; he plans a gradual phase-out its use. He does not apply any chemical pesticides on his rice crops.

Comparing the labor requirement and cost, yield and selling prices between the BIMAS and the IPM practices Mbah Slamet noted that there was no significant difference labor cost. Also when comparing yields produced by both system there were no significant difference. With IPM and the alternative agriculture system, an average yield per 1000 meter square is about 7 quintals of dry grain; whereas using BIMAS system with chemicals the yield ranges between 6.8 – 7.2 quintals of dry grain. On the selling price he earns more with IPM system of rice cropping using *mentik wangi* heirloom rice in comparison BIMAS system using IRRI rice IR64. Selling price of *mentik wangi* is ID Rp. 3,300.00 per kg, while IR64 rice sells about ID Rp. 2,200.00 to 2,300.00; this makes about 43% price differences between the two products. The difference of take home revenues to farmers practicing IPM is about ID Rp. 700,000.00 per 1000 meter squares of rice field.

Mbah Slamet indicated that alternative agriculture was practiced for centuries before the introduction of BIMAS. There was the time when farmers cultivated heirloom or local seed, made use of household, livestock wastes and manures for compost, and controlled pests using available materials and the use of traditional technology. Traditionally farmers were using *pranoto mongso*, the ancient farming calendar, to guide their farming schedule and the type of crop to plant as well getting the proper instruction and cautions of potentials pest attacks and how to avoid them. He remembers how farmers were using freshwater crab carcasses to attract rice seed bugs so they didn't attack the rice crops. All these traditional practices are lost with the government's iron-fisted imposition of the BIMAS program on farmers. With BIMAS farmers also lost their freedom. With the IPM now farmers have learned more to improve their agricultural practices. For example, as an improved method of controlling *walang sangit* or RSB now farmers know that dead RSB due to contamination of *Beuvaria bassiana (Bb)* fungi could be used for spraying RSB as well as BPH and kepiding tanah or black bug (*Scotinopara sp.*). These pests are the most dangerous that could attack rice crops. Some farmers through IPM science meeting have learned how to inoculate *Bb* in rice or cassava media so it becomes available in larger quantity to fellow farmers.

Mbah Slamet further stated about the benefits and the beauty of IPM and the alternative agriculture as follows:

a. The IPM practices and their modifications are to improve better farming results by mainly optimizing ecological environment and farmers' local resources. Farmers are encouraged to use their judgment in order to improve their farming achievements.

b. This improvement effort is carried out with full awareness of the benefits of farming using natural materials in their agricultural production. Technology selection and application in improving farming revenues should not interfere with nature and the environment.

c. Farmers become critical to their own farming practices. The new understanding of inter-relationship between their farming practices that potentially affect the fertility level of their soil, the equilibrium between pests and their enemies in the rice fields and becoming aware that whatever they do in their farms will have a long term implications. This could be positive or negative; it depends on what path of farming practice they choose.

Mbah Slamet stated that while he was still working as civil servant he had less concern about the world of agriculture, but afterwards, when he retired and became involved in farming he realized, how much had been lost to BIMAS' ban on many traditional and environmental friendly agricultural practices. If hypothetically the government were to impose another ban on traditional agriculture, and begin dictating to farmers what they have to do, Mbah Slamet said he would stand up and oppose such policy.

Getting Involved with IPM

Mbah Slamet learned about IPM for the first time in 1989, and he started taking part in IPM meetings in 1991. He immediately saw the difference in approache between the IPM and the BIMAS system. He pointed out major differences between the two systems. The BIMAS system emphasizes the achievement of high productivity agricultural outputs using modern agricultural technologies. The IPM approach emphasizes improving the farmer's understanding of agro-ecological aspect of their farming activities in order to grow healthy crops; to be vigilant by observing the field weekly; to control the pest population using their natural enemies; and finally to develop their expertise to manage the crops effectively. BIMAS instructed rigid guidelines to the farmers about what to plant in their fields, what crop variety they could plant; what fertilizer they should use and what pesticides were recommended to control the pests. And all these instructions carried a significant price tag; all were wrapped in a credit package farmers have to pay after their harvest. BIMAS high yielding IRRI varieties are sold at lower prices because of their inferior tastes and aromas. In BIMAS, farmers lost control of their farming activities and their freedom. With IPM Mbah Slamet found the ideal farming system where farmers operate in their freedom to determine the best farming practices for themselves.

Mbah Slamet is now an IPM *petandu* (*petani pemandu*) a farmer that carries out IPM training to other farmers. In conducting the training, he uses IPM training modules extended over the period of one cropping season. He is in charge of training at least 15 farmer groups located in his sub-district of Imogiri. He conducted these trainings on voluntary basis. His altruistic motive made him feel happy to spread his IPM knowledge and experiences to many farmers; and this way he built his networks and friendships with other farmers from outside of his area. Sometimes he received money for the training, but he never demanded payment nor determined the amount farmers would pay.

Doing the IPM training

Spreading the knowledge he learned about IPM to other farmers is exciting to Mbah Slamet. Besides doing training in the fields he also enjoys seeing how the IPM concepts and ideas spread among the farming communities through *getok-tular* or word of mouth and *tukar-kawruh* or exchange of ideas. Together with his farmer group he made an IPM brochure to be used as a supplement to training activities he conducted. He had been invited three times to speak and share his IPM experiences in Agricultural Extension Services in Sukamandi and two times in Subang, West Java. He was also asked to conduct IPM farmers field school (IPM/FFS), in Indonesian known as Sekolah Lapangan Pengendalian Hama Terpadu or the better known acronym SLPHT. He was also invited by the academic community to help university students doing their practicum.

He perceives that his IPM experiences are personally convincing and successful and that this knowledge should be shared with other farmers, otherwise they will not have the opportunity to learn and experience these IPM practices. Male and female farmer groups and the university students for the above-mentioned reason mainly attend the training he conducted so far. During the training, he likes to entertain questions and enjoys feedback from the farmers to measure his performance during the training.

Initially through IPM, Mbah Slamet found his interest in reinventing the ancestral agricultural knowledge and practices. He found that IPM is an encouraging vehicle for this. He started to do *tukar kawruh* or exchange of ideas with his fellow farmers. These *tukar kawruh* activities were followed on with field trials and experiments. According to Mbah Slamet alternative agriculture is an ongoing process of improvement, a process that relies on farmers' inputs, ideas, and innovations. The whole process should be open and run democratically.

Mbah Slamet makes his own observations and conducts his own research. Only after rigorous testing will he share his findings to other farmers. His research focuses on finding and mixing ingredients available locally that he uses to control the pest population. He performed a small-scale experiment in his own field with intensive observations. He expects government to play an active role in providing the necessary support for farmer innovations and help farmers market their inventions. He mentioned that in a globalize economy the government must provide initiatives to protect the interests of the farmer from being taken over by corporations.

Disseminating the IPM knowledge

As an IPM farmer trainer, Mbah Slamet was often invited to speak on the issue of alternative agriculture. His fellow farmers often came and visited him at his house for discussions and exchange of ideas. They also discussed problems they encounter when cultivating their crops or any other problems they would bring for discussion. Mbah Slamet's effort in disseminating the IPM knowledge was done to a wider range of audiences. Although his efforts mainly focused on farmer groups adjacent to his area, he also shared his IPM experiences to university students.

Mbah Slamet conducted IPM training to a group of female farmers in the sub-district of Imogiri, where he lives. He introduced the IPM system of farming as a system that is friendly to the environment. His opening statement excited them: In contrast to the BIMAS agricultural system that causes environmental damage and requires high costs for agricultural inputs. Those women became interested in the IPM ideas and wanted to learn more. When asked what he found interesting in conducting his IPM training to women farmers, he replied that found these characteristics apply to the group of women he trained:

a. Female farmers are more attentive to the issues introduced during the training
b. At the same time, they are more open to new ideas
c. They also become more enthusiastic in trying new experiences
d. They retain the knowledge and skill better than their male counterparts.

Mbah Slamet found that facilitating IPM training and sharing his IPM experiences to a group of female farmers is very rewarding simply for the above reasons.

Female farmers are attracted to ideas of cutting down their agricultural production costs, improving the environment, and safeguarding the health of their families.

Comparing his experiences in training a group of female farmers with a group of the male farmers, he thought that both were similarly responsive to the

IPM ideas when introduced to the ideas. However, their responses were somewhat different regarding activities requiring muscular strength such as making compost. Male farmers found no problem in accepting this challenge. On the other hand, women farmers are more responsive on issues related to home economics. Mbah Slamet believes the differences in their responses to IPM ideas are dependent on the work distribution within the farming households where male farmers will carry out heavy duty activities like land preparation and transporting harvest from field to storage while women carry out lighter activities requiring tidiness and neat works like weeding, food processing, and home economics.

Involvement in Farmers Science Meeting

Mbah Slamet claimed he played an active role in the farmers' science meeting at the provincial level. He was involved quite routinely in this science meeting because this forum facilitates sharing of information and innovation among farmers especially in relationship to their IPM farming practices. He found the farmers' science meeting was a positive forum where farmers could exchange information and learn from one another about grassroots technologies and the latest development in their agricultural activities. He also found that this forum was created the farmers own initiative.

Mbah Slamet often shared his ideas related to promoting organic farming. Farmers are responsive to ideas or innovations presented by other farmers. Farmers' science meetings become a forum for farmers to farmers and for the improvement of their farming activities. This forum covers almost all IPM and alternative agriculture topics including: organic farming, the making of natural fertilizers and organic pesticides, using plants to repel pests, and promoting ecological agricultural approaches.

Involvement in the National IPM Farmers Association (IPPHTI)

As note above, Mbah Slamet was involved in the founding of IPPHTI as part of their first congress in Moyudan, Central Java in 1999. He was involved in the health committee during the *musyawarah* or congress in 1999. He also took part in formulating the IPPHTI concepts. He was one of the members who met with the Secretary of Agriculture who signed the government's recognition of the group as the national IPM farmers association. That historical moment practically gave birth to IPPHTI.

He believes IPPHTI is running in a good track by keeping its founding mission to improve environmental damage and to encourage ecological farming approaches using materials available to farmers. Though he recognizes that there are significant disagreements on the programming issues among the leadership, Mbah Slamet still believes that IPPHTI could be the right vehicle to improve the lives of farmers in Indonesia.

CHAPTER 8

WHAT'S NEXT: IPM AND BEYOND

Organic Agriculture: Knowledge for Survival

The spread of agricultural communities that settle in one place marked a great shift in human history, from an endless migration of nomadic life to a settled life in one specific place. Communities of settlers normally found most of the resources they need to survive. Humans sought places with sufficient water, food sources, building materials and anything else important to sustain their lives. Traditional or indigenous or natural agriculture has always been a part of human culture.

IPM opened the door to innovations, innovations that were able to build on traditional farming methods. IPM enhanced pre-existing traditional methods and raised consciousness. These methods were consistent with the modern science of IPM. Thus, making compost from waste materials, though it is long known and used through human civilization, is now, better understood, because IPM's scientific approach for identifying micro-organisms that are and breaking down organic matter, taught many traditional farmers the "why" of their ancient practices. IPM asked scientific questions based on empirical investigations, traditional knowledge did not. IPM was launched in response to the destructive Green Revolution, which began in the 1960's with the introduction of miracle seeds. This dwarf Mexican wheat was capable, in laboratory conditions, of producing yields never before known in human history. This magical characteristic of the seeds was actually due to their responsiveness to urea, the manufactured nitrogen fertilizer.

The Green Revolution, with all the excitement surrounding its modern agriculture technologies, was intended to eradicate world hunger. For these reasons, all the modern agricultural fuel-based technologies were developed and exported around the world, sponsored by leaders of developed nations. The miracle seeds—first wheat, then rice, and then new varieties of other food crops—all required manufactured fertilizers, well irrigated, tilled soil, and controlled weeds and pests required in order to achieve the highest rate of harvest

In Indonesia, the Green Revolution was introduced to farmers as the BIMAS program. The Indonesian government found that farmers were not as excited as their government in embracing the Green Revolution. The government then heavy-handedly imposed BIMAS. This approach caused farmers' suffering and the loss of their fundamental freedom of choice. Along with this, they also lost much of their indigenous knowledge, the invaluable heritage of centuries of Indonesian agriculture.

The IPM campaign has been and remains an educational campaign. Through education and awareness building, IPM was able to build a strong foundation at the center of the farmers' learning process. As an agricultural system, IPM was launched as a critique about the Green Revolution's abuse of the environment, mainly by the massive application of pesticides. IPM intended to emphasize the importance of nature in the agro-ecological dynamic.

The Green Revolution detached farming activities away from the livelihood of the farmers, a comparable concept to manufacturing industry. In this concept, workers go to the factories to work and become productive making the products for the factory he or she works for. When they are done they go home and assume a different life style at home. Meanwhile IPM introduced a more integrated concepts of farm life which consider the food production activities related to issues on ecological balance, environmental and health factors, economic benefits for the long run and so on.

IPM viewed farming activities as a holistic process closely related to nature. Farmers, rice crops, pests, pest control, pests' enemies, fertilizers, family health, weather and climate and the whole living environment are all integrated in the farmers' livelihood. Farmers have to consider all these factors when they have to make the best decision, a decision that will affect their livelihood. None of these factors stands alone. They all part of a totality. The IPM training employed group dynamics in its learning process guarantying farmers' active participation and and encouraging their commitment to learning. It is true that groups do not learn, but individuals in the groups can excel in their learning.

The basic foundation of IPM-based agricultural practices is the realization that indiscriminate application of pesticides as suggested by the Green Revolution for controlling pests. Along with the bad insects, this spraying also kills a wide spectrum of good insects that prey on the pests and benevolent organisms that create balanced equilibrium around the crop, and in fact protect the crop from pest attacks. IPM introduced the need for understanding agro-ecological interrelationships surrounding the crops' environment by doing weekly crops observation.

Education is the Foundation of IPM

IPM introduced analytical skills about agro-ecological system through Adult/Non Formal education system. The Indonesian IPM program helped farmers learned IPM skills through the well known Sekolah Lapangan Pengendalian Hama Terpadu (SLPHT) or IPM Farmer Field School (IPM/FFS). This school taught the participating farmers to observe, collect, identify, find the local names, and understand how the presence of the small creatures they find around their rice crops effects the rice plants. Field observations are followed by small group discussions. These activities take place every week so farmers can observe changes and growth patterns of pests and their enemies in the rice crop. The IPM/FFS activity runs for a season-long period, from planting through harvesting.

This educational component is the key to new understanding, higher levels of knowledge and awareness. The three farmers, Pak Murdjiyo, Mbah Suko and Mbah Slamet, were impressed with the liberating effects of the IPM system of education. Their training with IPM helped them regain their courage to claim ownership of ecological farming practice knowledge. This ownership of knowledge had been abandoned for decades despite their longing for its revival. It was getting blurred over time with suppression by the government and denial of the owners and the inheritors of this knowledge, the farmers themselves.

IPM farmers changed from practicing the BIMAS agriculture to practicing the IPM agriculture and now are moving further ahead by farming organic. In the year 2003, the government of Indonesia, along with other nations of the world declared to "*Go Organic by 2010.*" Indonesia's government has promoted this goal and has translated it into the Indonesia agricultural policy.

Personal Realization of the Superiority of Indigenous Knowledge

The critical assessment of the Green Revolution in these pages resulted from my own conversion. I had been an adamant supporter of the Green Revolution. While working for Catholic Relief Services, an East Timor Agricultural Development program (CRS/ETADEP) in 1983-1985. At the time, I was struck by the fact that not all traditional technology or practices were necessarily inferior to the modern technology. I saw how traditional technology, i.e., land preparation using water buffaloes, was superior to modern farming technologies. Modern machine technology meant running heavy-duty tractors to overcome the grass problem that is rampant in the Timorese lowland. That experience touched me deeply in that it changed the way I viewed Indigenous people and their knowledge. I began searching for what was deeply buried in that iceberg of the indigenous survival wisdom. I suggested to my superior that the ETADEP project should adopt this practice of the local Timorese.

My superior had worked for at least twelve years as a sociologist directing a community development program in the neighboring island of Sumba. Being a sociologist and community development activist, he agreed to the idea. One evening, over a cup of coffee, we combined this ingenious indigenous practice with our modern heavy duty tractors. After detaching the Rotaslashers[27] from the tractors and put the floating-wheels[28] on the tractors, the tractors were driven back and forth over the fields of tall wild cane grass, scientifically known as *Saccharum spontaneum*. This pernicious wild cane grass bends down and perishes, after being trampled and broken by buffalo hoofs. When mixed with mud and water, this giant grass, though still considered small when compared to bamboo, decayed and become the part of organic matter, good nutrient for the crop. With floating-wheels driven back and forth over the reclaimed rice fields, the tractors trampled the grass as the water buffaloes did. With this simple adjustment in our project's tractors, we tapped in the wisdom of Timorese and subjugated the modern agricultural technologies to serve farmers better and faster. We could not throw away the entire five million dollar project but at least we could operate and manage the project to produce the maximum benefits to participating farmers.

From the narrated data in chapter 7, I found that the three farmers who were interviewed shared many things in common; their perceptions, experiences, and the negative impacts of the imposing BIMAS program. All three of them explained how much suffering they have to endure during the program, how the program had created negative effects on their crop production. It further impacted the health of the farmers and their families. The use of pesticides poisoned their bodies and polluted the environment. They also pointed out that

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[27] An agricultural implement attached to a tractor for cutting grass. It is basically an industrial size of home lawn mower.
[28] Floating wheel is a set elongated steel pedal put in a wheel formation. It attaches to the tractor wheels to keep the tractor from sinking when working in a deep muddy soil environment.

BIMAS agriculture had caused the significant losses in many of the natural, traditional agricultural practices of their parents and grandparents. These losses extended to the losses of social and cultural fabrics of their society, plus the losses related to environmental degradation, losses of *germplasms* of many heirloom crop varieties. Some of the losses are listed as follows:

1. Farmers lost their freedom and were doomed to become slaves in their own land. They had no right to express concerns with the BIMAS program. Farmers felt a tremendous sense of loss as they were not free to be masters of their own land. This was a common reaction among farmers when they found that they had no other choices but to be a part of the BIMAS program. They felt helpless and could not challenge the imposed program. After four decades of ceaseless indoctrination, broken promises, gimmicks, and lucrative credit schemes, the farmers finally lost their resolve. Many found it easier to become ignorant and naïve in order protect themselves and their families from further abuse and retribution from the government. Farmers had to pretend to always agreeable to the government stand so they won't be identified as someone opposing to the country's most important program that is to feed the nation.
2. Farmers lost their indigenous knowledge. In the name of applying modern agricultural technology, BIMAS banned most of farmers' indigenous practices in land preparation, seed selection, using manure or compost, and in controlling pest the traditional way. Traditional or indigenous knowledge was ridiculed. Government officials systematically took the

lead in making traditional farmers looks bad and feeling uneasy if they continued to follow on the traditional system. Farmers who insisted on making compost were often criticized by fellow farmers for being "obsolete". The three farmers confirmed that BIMAS was the major cause for the disappearance of much agricultural indigenous knowledge. These losses almost came to level of irreparable, where these losses could become permanent.

3. BIMAS controlled the market price by placing a ceiling or cap price during *pacelik* (food scarcity period in between harvest seasons) and a bottom price during harvests season. Farmers complained about receiving low prices when their harvests were in abundance. The bottom prices were set to protect farmers as their price fell. But this made them dependent on the one and only market channel for selling their products to *Kredit Unit Desa (KUD)* or Village Co-operative Unit. KUD was not a real village co-operative group, but merely the extended hand of the government monopoly. KUD was a sub-district level government unit provided services to farmers as:
   - Buyer of farmers rice with bottom price protection
   - And seller of agricultural inputs required to implement BIMAS practices. From KUD farmers could also buy the needed agricultural inputs for BIMAS system provided through the government credit schemes, these included pesticides and inorganic fertilizers.

This system was created to protect farmers from becoming the victims of unfair trade and in guaranteeing immediate supply of agricultural inputs when the farmers need them. In reality, KUD become known for its corruption. Stories were rampant about how KUD staff manipulated the scale, demanded for bribes, or told farmers in the isolated area the wrong price quote. These official price quotes were announced by the government at the central office coordinated through National Bureau of Logistic (BULOG). KUD was the government's agent for purchasing rice from the farmers to be stocked for the in-kind portion of civil servant salaries. KUD tried to keep the market price from falling further below the fair price for the farmers. In the system where everything was controlled from the central office in Jakarta, farmers easily became victims of manipulation and exploitation by government officials who received low salaries. These low grade officials and suffered of low morale.

4. BIMAS caused the decline of many social structures in the farming communities. The use of the short-handled serrated sickle knife in harvesting dwarf IRRI rice crop varieties wiped out the use of *ani-ani*, a knife that had long been used for harvesting long heirloom rice panicles. Farmers who helped in harvesting heirloom rice using *ani-ani* are entitled to one-eighth the amount they harvested as payment. The replacement of *ani-ani* harvester knife signified the loss of local sharing of harvest as farmers' friends and neighbors were now unable to collect their in kind payment for their work in assisting the manual harvesting. This loss of

simple sharing of harvests, the joy of all seasons with neighbors and friends, also led to the disappearances a number important social and economical event in the villages. For example:

- Poorer people in the community lost their opportunity to take part in this harvesting event that allows them to carry food home to feed their families.
- With the traditional *ani-ani* harvesting tool, more harvested rice remained in the village and helped the local poor to thrive. Harvesting with ani-ani normally done selectively which means some green panicles can stay in the field for while until the owner decided to make a second round harvesting.
- Whereas the BIMAS' short-handled serrated sickle makes harvesting easy so field owner did not need help from the poor neighbor to harvest the rice. Rice harvested this way is usually for sale. Harvesting is usually the work of a small group of 3 to 4 persons. Serrated knife is designed to avoid a lot of shaking when making the cut; that way less grain will fall off the panicles. Most IRRI rice grains fall off the panicles easily.
- The short-handle serrated sickle becomes a very efficient harvesting tool. In case of farmers decide to sell the rice to a wholesale buyer; the buyer could come in a short notice with a harvesting crews and a truck. A team of 3 could harvest a 1000 square-meter rice in about an hour. The harvesting job done this

way will take away the rice from the village economy. The poor in the village have no opportunity to take their much needed cut of their neighbor's harvest through rendering their services.

5. BIMAS ended the *gotong-royong* practice and brought in the individualistic capitalism to Indonesian villages. This spirit of mutual cooperation of *gotong-royong* that existed traditionally in many farming communities are now gone with the change from farming for subsistence to farming for cash or profits. All three farmers mentioned about this loss clearly in their responses to the interviews. Spontaneous social mutual cooperation and work-sharing to help one another and lend hands to those who needed help has now practically ceased to exist. Individual and communal projects traditionally were carried out with *gotong-royong* spirit. People now tend care for themselves and their own families.

6. BIMAS caused the loss of almost all of the heirloom/local rice varieties as well as other local food crops. Cultivation of heirloom seeds was banned by the government at the time of BIMAS. The program promoted dwarf IRRI rice possessing certain quality characteristics such as:

   - High yield producing capacity
   - High response to urea, a nitrogen inorganic fertilizer
   - Resistant to brown plant hopper
   - Mature in 100 days

   For the above reasons, BIMAS never endorsed the cultivation of heirloom rice in the program. The later BIMAS allowed the planting some of the heirloom rice varieties like *Rojolele, Krueng Acheh, Cianjur, Mamberamo and Cisadane* for their high market values related to people preferences to their aromatic tastes.

7. BIMAS produced a generation of farmers who were dependent on outside resources. None of the BIMAS program components relied on local, readily available sources which are affordable and plentiful. BIMAS program packages launched through its credit package reflected the high dependency of inputs from outside resources. Farmers could only afford to participate in the BIMAS program by credit loan packages. The loan packages contained various incentives like the allowance to sell their rice product to KUD and waivers of credit loan payments when they experienced harvest failure. BIMAS' high cost of production deluded farmers into thinking that they were being efficient in their agricultural practices.

Comparing rice cultivation practices among BIMAS, the IPM, and traditional agriculture showed they differed. Though, IPM did not revolutionize crop production in opposition to the BIMAS system, as the program's success came from encouraging farmers to observe, analyze, and make informed decisions. It provided initiatives and opportunities for the farmers, so that they could reinvent the lost practices of indigenous knowledge. The following table 7 was created to compare the practices of three systems: the Indigenous/traditional agriculture, BiMAS system and the IPM.

Table 7: Comparison of Rice Cultivation System

	Traditional Agriculture	**BIMAS agriculture**	**IPM agriculture**
Irrigation	Mainly rain-fed or traditional irrigation done by diverting water from the river or small stream.	Applied the technical irrigation done by constructing enormous dams and water reservoirs built using international loans.	Support using any system that was available to the farmers.
Seeding and planting	Plant heirloom rice variety using traditional transplantation from seed-bed to the rice field.	Plant mainly IRRI rice. Later during the program farmers were allowed to plant some local varieties that resist BPH.	Respect farmers' decisions based on what farmers think is best for them.
Fertilizing	Using composts and manures	Inorganic or manufactured fertilizers	Respect farmers' decisions based on what farmers think is best for them. Natural, homemade liquid fertilizers were introduced as farmers' initiative.
Weed Control	Done manually by pulling the weeds or using small hand-weeding implement	Suggested the use of herbicides when manual labors were scarce.	Use no herbicides. Any system that does not upset the agro-ecological balance was supported.
Pests Control	Done using traditional pest repellent, pest attractant and natural ingredients	Done using poisonous chemicals that have nerves system paralyzing effects such as organophosphates (OP) and carbamates.	Use no pesticides. Any system that does not upset the agro-ecological balance was supported. Natural, homemade pesticides were introduced as farmers' initiative.
Harvesting	Done using *ani-ani* harvester to cut rice at the panicle and applied social sharing system of harvesting.	Done using short-handled serrated sickle to cut mature rice plant at its base	Respect farmers' decisions based on what farmers think is best for them. Revival of using *Ani-ani* for harvesting.
Post Harvest Processing	Post harvest food processing like threshing and hulling[29], were done manually. Nutritious rice-bran is still attached to the grain. A good source for vitamin B.	Post harvest food processing was done using small rubber roller rice huller. Polished[30] rice becomes the outcome of these machines.	Support using any food processing system that was available to the farmers.

The three farmers were in agreement that the entire BIMAS practice was harmful and counterproductive. In general, it created negative environmental impacts

[29] Threshing is a process of detaching the rice grain from its panicle. Hulling is a process of detaching the rice husk from the grain.
[30] Polished rice is rice grain or rice kernel which bran has been removed completely. Polished rice has lost its highly nutritious component i.e. the rice bran, which is rich in vitamins B.

and degraded the quality of their soil. They all agreed if BIMAS model of agriculture were (hypothetically) to be carried out as a national program again, they would object and resist.

The farmers preferred the IPM program to BIMAS for a number of reasons, including the following:

1. IPM liberated farmers, increased the farmer's capability to make decisions, and gave farmers more control over their farming activities. Farmers were empowered to make their own decisions in farming practices and were free to choose what they judged to be the best practices. With IPM, farmers were prepared to become managers capable of making informed decisions.
2. IPM helps farmers understand the agro-ecological system which co-exists with their rice crops, by encouraging regular field observations and critical thinking through analysis and research. The program also discouraged arbitrary use of pesticides by showing farmers that pesticides are not a production factor in rice cropping. IPM also helped farmers appreciate that rice produced free from poison was of a higher quality and is rewarded with higher market prices.
3. IPM is friendly to the environment and allows the farmers to enjoy better and healthier lives, free from poisons and pollutants.
4. IPM helps farmers enjoy many traditional values that were banned by the BIMAS program. Under IPM, farmers reorganized themselves through farmer groups and water users associations. Farmers began using

traditional technologies, such as *ani-ani* for harvesting heirloom rice. IPM revived *gotong-royong,* the communal cooperation and the spirit of working together and sharing. This communal sharing had been with farmers for centuries and was now revived and enlivened by the IPM approaches.

From IPM to Organic Agriculture

Today the IPM program is faced with the question: "What is next? What is there after IPM?"

The IPM program leaders as well as the loyal IPM farmers have to answer this question. The answers were already on hand when the farmers finished and graduated from FFS/IPM training and actively joined in the follow-on IPM activities. They had become involved in the initiatives for research and innovation. It seems inevitable that farmers will see that IPM methods imply a complete system of organic agriculture. A modern organic agriculture could be defined as agricultural system that employs agro-ecological approaches and optimizes nature in food and other agricultural products. Organic agriculture systems require that cultivated soil be free from any chemical entities. Soil that was used for conventional agriculture, like the Green Revolution, has to go through a moratorium period. European Union (EU) decided a ten year moratorium period for soil that was previously used in conventional agriculture to claim its title as organic soil and then could be certified as organic soil.

Indonesia Go Organic by 2010

Back to Nature has become the world's twenty-first century slogan, especially when it relates to agriculture. People are increasingly aware that the uses of hormonal growth enhancer, pesticides, and manufacture fertilizers have all had harmful effects on human health and the environment. This "natural" lifestyle has also experienced international institutionalization, because of the global trade regulation requiring that the agricultural products must bear safety attributes to be sold and consumed (food safety attributes). Other rules required high nutrition (nutritional attributes) and environmentally friendly farming methods (eco-labeling attributes).

This increasing demand for organic agricultural products has grown at an average rate of 20% per the year. This demand was dictated by consumer's preferences from all over the world. The World Trade Organization (WTO) data showed that in the year 2000 the trade of organic agricultural products in the world reached a value of US$ 17.5 billion. It was estimated that by the year 2010 the world's market share of organic agricultural products will reach US$ 100 billion (Department of Agriculture of Indonesia, 2000).

Indonesia is a country that was blessed with rich biological diversity, a unique tropical climate, abundant water, and sunshine all year around. These advantages gave Indonesia an extraordinary foundation and encouraged the capital for development organic agriculture. Indonesia's competitive advantages have helped it become one of the leaders in organic food production. Indonesia has the opportunity to dramatically improve the well being of its people, especially the farmers.

Organic agriculture is the holistic system of integrated agricultural production that combines healthy food production with a sustainable, natural agro-ecosystem. It seeks to:

- Avoid use of genetically modified seeds (GMO)
- Avoid use of synthetic or manufactured chemical pesticides in controlling pests and weeds. Pest and weeds should be controlled mechanically or biologically by using beneficial organisms or by rotating crops.
- Avoid any use of artificial growth regulators and synthetic chemical fertilizers. Improvement of soil fertility should be done by adding organic matter into the soil such as application of manures and composts, and natural mineral stones. The use of leguminous trees and crops rotations are also recommended.
- Avoid using synthetic hormone additives in food for farm animals (Department of Agriculture of Indonesia, 2000).

Responding to the above challenges and opportunities, Indonesia has declared the goal to "Go Organic by 2010" as a way to accelerate the development of environmentally friendly agribusiness and find ways of improving the quality of life of the Indonesian people, beginning with the farmers. The vision of this initiative is to bring about Indonesia as one of the largest organic food producers in the world by the year 2010 The government hopes to realize this vision by pushing the expansion of competitive and sustainable agriculture by professional partnerships and services (Department of Agriculture of Indonesia, 2000).

The Department of Agriculture of Indonesia (DOA/I) has responded to the world challenge by setting up agricultural policies, developing strategic plans, and mobilizing resources. On my last visit to Indonesia in December 2003, I listened to farmers, discuss this initiative. One of three men interviewed, Mbah Suko reacted enthusiastically. He said that he never imagined that the government would launch an initiative that supported moving IPM based agriculture and recognized the necessity of organic and sustainable agriculture. Never in his life had he dreamt that government initiatives would finally reflect what he had been doing for the last ten years in IPM. Pak Murdjiyo, on the other hand, was a hesitant in responding to the “Go Organic by 2010” DOA/I declaration. His experience with the Indonesian Department of Agriculture has never been positive. He had some hope, but at that moment wanted to “wait and see.” Mbah Slamet was also hopeful that government’s initiative declaring going organic by 2010 would impact positively on Indonesian agricultural production and make significant improvements in farmers’ livelihoods.

The DOA/I’s initiatives are good; farmers should be supported in becoming the part of this national effort to put Indonesia on the world map as one of the world largest organic food producers. Reading the vision and mission of “Go Organic by 2010” publish at DOA/I web page, it looks is very positive. DOA/I Directorate of Food Production clearly states their intention to “Go organic by 2010,” and describes their strategy for mobilizing resources to achieve the challenge. There is concern about the time factor here. Ten years might a little bit too short for meeting such a big challenge, considering that much of Indonesian productive land have had previously used (or still being used) for conventional food production. As previously mentioned, the EU requires a moratorium of at least ten years before any land previously utilized in conventional agriculture is allowed to pass their organic certification. Indonesia should not let this opportunity pass. Indonesia should utilize its current momentum to launch this national campaign. DOA/I Directorate of Food Production should optimize the resources inventory and mobilize those resources for the benefit of the farmers, especially small holders.

In the last analysis, the three farmers were moving in the direction of organic agriculture. And they are not alone; there are hundreds of thousands more Indonesian IPM farmers who are ready practice organic agriculture. Many have stopped using synthetic pesticides and manufactured inorganic fertilizers. By the year of 2010, many of these farmers could obtain worldwide organic certification. Farmers need assistance in order to sell their produce at a fair price. Knowing there is world demand for their products; farmers will work hard to meet that demand. They will work very hard because they are motivated to receive a better financial benefit if it compares to selling locally.

Historical Review of Recent Indonesian Agriculture

From the recent history of Indonesian agriculture, we can trace the milestones of agricultural from the ancient time until now, and then construct a time frame for all those historical changes. Table 8 was created to show the milestones of changes that affected the Indonesian agricultural system. This table highlights the roles of the Indonesian farmers, during historical time and who got involved in those events. This also shows how decisions made at the top level created tremendous consequences to the farmers at the very bottom of the social structures. This table also shows how farmers could initiate significant changes to agricultural practices in Indonesia.

Table 8: Milestones in the Recent History of Indonesian Agriculture

Time Milestone	What happened?	Who got involved?	The roles of Farmers
Since the beginning of agriculture	Indigenous or traditional agriculture	Indigenous communities and farmers	Active sustainable subsistence
1940	Initial research to find the super-seeds	Dr. Norman Borlaug, Research station funded by Rockefeller Foundation and Ford Foundation	Not involved
Early 1960's	The finding of Mexican dwarf wheat that was highly responsive to urea. The creation of the Green Revolution	Research stations, Agricultural experts; government aid money started flowing into funding this research; FAO, International Agencies.	Not involved
Mid 1960's	Expansion: more super seeds on different staple crops like rice, corn and potatoes.	Founding of many International research centers for food crops, like IRRI in Los Baños, the Philippines.	Not involved
1965	Indonesian coup d'état, Suharto military regime took over power from Sukarno civilian dictatorship.	Changed of Indonesia's ideology to anti communism and western orientation	Suffered tremendously; among the estimated 1 million casualties about 95% were farmers.
1968	Adoption of the Green Revolution by DOA/I by launching BIMAS program for rice Creation of the Indonesian Rice Research Center	DOA/I, IRRI, International funding Agencies	Passive Recipients of the Green Revolution: instructions, credit packages and other gimmicks.
1973	Major outbreak BPH, a devastating pests	DOA/I, Local Authorities were covering the truth about harvests loss	Suffered tremendously; farmers from the rice bowl areas on northern coast of Java suffered famine due to 3 consecutive harvests failures.
1984	Indonesia declared self-sufficiency in rice	DOA/I, Government of Indonesia	Window dressing, big smiles, celebrity time.
1985	Another major outbreaks of Brown Plant Hopper (BPH), Indonesia back to becoming the largest rice importing country	DOA/I, Government of Indonesia and Local Authorities	Suffered tremendously; Farmers bore the burden of bringing production back up to the level of 1984

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Table 8 Continued

1986	Suharto releases presidential decree no.3/1986 that banned 56 Organo-Phosphate pesticides; This decree became the foundation of IPM.	National Planning Agency; FAO; USAID by funding $ 5 million	Not involved
1986	Founding of IPM program by FAO and National Planning Agency. The early IPM training for pest observers (PO), DOA/I abolish the annual $ 100 million subsidy for pesticides.	IPM program staff, POs, farmers' leaders	Early active involvement of some farmers. Many become confident IPM farmers and IPM farmer trainers.
1991	Full run of the IPM program: FFS/IPM, Follow-on programs, Farmers Technical/Science meetings, various IPM communication activities by IPM farmers.	In this year the program is renewed for another 5 years, but now under with multi lateral instead of unilateral funding by USAID.	Farmers actively involved as they learn about agro-ecological analyses during their FFS/IPM training; IPM is becoming very popular among farmers. It spreads by word of mouth (*getok-tular*). Farmers reclaim the ownership of agricultural knowledge; they become the bosses in their own land again. Many farmer-sponsored IPM training activities and initiatives, IPM research. Revival of indigenous knowledge. Farmers attain high level of understanding in matters of health, environment and sustainability.
1997	The founding of IPM Farmers Association or IPPHTI in Moyudan, Central Java.	Farmer leaders, IPM activists, Secretary of Agriculture	Farmers demand national recognition of their IPM initiatives and efforts. More and more farmers stop using inorganic agricultural inputs in their farming activities.

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Table 8 continued

2001	FAO end all funding for the IPM program. The IPM program is closed down.	FAO, DOA/I	Farmers continue their own IPM initiatives and research. Increasing trend for going completely organic among the IPM farmers.
2003	Declaration of "Going organic by 2010" by DOA/I	DOA/I responding to global market demand on organic food products.	Some IPM farmers responded enthusiastically, some with suspicions.

Dealing with the Issue of Sustainability

Angelina M. Briones from University of the Philippines, Los Baños, wrote a reference paper for PCARRD input in the Third Regional Workshop on Strengthening Research and Policy-Making Capability on Trade and Environment in Developing Countries held in Havana, Cuba on May 26-29, 2000. This paper, entitled, *Organic Agriculture in Asia: Implications to Development, Environment and Trade in Developing Countries*, provides a sustainability framework for agriculture and food production. Briones explains: The sustainability framework for agriculture and food production consists of a trilogy of equally important and mutually interacting and reinforcing objectives for social, economic, and environmental sustainability. A simple triangular model may be visualized with social and environmental sustainability at the base and economic sustainability at the apex. The relevance of a framework that gives equal importance to social, economic, and environmental objectives is evident from the fact that Asia, with almost 60 percent of the world's population, is home to two-thirds of the world's poor. This is a scenario that requires pursuit of the interdependent components of the sustainability framework. Such interdependence is evident even from a brief description as given below (Serageldin ,1993a, 1993b).

Briones then elaborates on the three components of sustainability are equally important and mutually interact with one another. She describes the sustainability trilogy as follows:

1. **Social sustainability** refers to structures, functions, and management designed for society to use and develop its resources in a sustainable way. The resources for agriculture and food production are of foremost importance. Social sustainability reflects the capability and character of a society, which stems from the capability and character of its individual members. This human capability also pertains to the human capital that is also a component of economic sustainability.
2. **Economic sustainability -** has been defined as keeping the capital intact as it is used to generate economic growth. However, the concept of capital did not give equal importance to the four forms of capital, i.e., human-made, natural, social, and human. Formal institutions have addressed the human capital (investments in education, health, and nutrition) However, functional illiteracy, poverty, and hunger continue to plague the nation. For example, farmers in Asia are expected to regenerate the land in order to produce adequate food for a rapidly increasing population, but have not received adequate schooling
3. **Environmental sustainability -** A common knowledge about natural resources is their utilization to provide for people's basic

needs and welfare of the society. Society relate to the wisdom of using natural resources for sustainable food production and sustainable development. The earth is commonly seen as a provider of everything for humankind. It is seldom thought of as sink for humankind's enormous wastes. Humankind must learn to live within the assimilative and regenerative capacity of the natural environment. Society today and in the future should prize a healthy environment. Such global concerns are hardly appreciated by the rural poor of Asia whose immediate needs could be parcel of land (for the landless), a bigger piece of land (for the near landless), or access to market and basic services (for those in remote areas) (Briones, 2000).

Obviously, people who enjoy the economic and social benefits of the farmers' toils can easily call for environmental protection. However, in countries where millions of the rural poor extensively cultivate lands, there is no other way but to tackle simultaneously the social, economic, and environmental objectives of sustainability (Briones, 2000).

Briones linked the three sustainability frameworks and suggested that a congruence of the objectives of organic agriculture (OA) with the above triangular sustainability framework is remarkable. Well-designed and managed organic farms in rural Asia have already demonstrated that the three sustainability frameworks actually work. Non-government organizations (NGOs) in many countries around Asia have also used the sustainability framework in their development projects with an approach called low-external-input-sustainable-agriculture (LEISA). This program showed varying degrees of success but its outreach was limited. LEISA believes that the framework is applicable at national level and could address the huge problem of household food security among the rural poor if supported by relevant policies and effective promotional campaigns (Briones, 2000).

IPM can be categorized as LEISA from the farmers' level perspective, yet judging from the way IPM conducted its program at the national and international level, it is hard to say that IPM outreach is limited. The spread of the IPM knowledge among farmers would disprove Briones statement that "their outreach is quite limited." Dilts and Pontius conclude in *Lessons Learned from Farmer Field School Programs*, a copy of this paper also available in Apendix C:

> The cases demonstrate that a spread effect exists because of IPM training. IPM trained farmers talk to other farmers about what they learn in Field Schools. Alumni and Farmer IPM Trainers organize activities to help other farmers learn about IPM. Field studies are used by farmers to demonstrate IPM principles. Alumni organize and re-activate Farmers Groups to provide forums for IPM trained farmers to help others learn about IPM. One reason alumni are committed to teaching others about IPM is that they realize that for IPM to most effective it should be applied on a *hamparan*-wide scale. The cases have documented how religious or cultural tenets also motivate alumni to spread IPM among friends and neighbors (Dilts and Pontius, no date).

Dilts and Pontius also explain the reasons for this energetic spread of the IPM knowledge after the FFS/IPM training:

1. Alumni master Field School methods because of the frequent repetition of activities and processes. This means that alumni can use many Field School learning methods to teach other farmers (for example, insect zoos, field studies, or field observations).

2. FFS activities are not dependent on materials that are centrally produced; they are dependent on a process and on farmers producing their own materials. Thus informal approaches by alumni to other farmers are not limited by lack of materials; alumni can produce what they need.

3. The discussion, presentation, and dialogic skills learned by alumni during the FFS can be used by alumni to help others leam about IPM.

Dilts and Pontius also mention the level of external input to IPM program by looking at the cost of FFS/IPM.

> The target for costs per farmer trained in a rice FFS is US $10.00. Since 1990, the costs have fluctuated above and below that figure. Farmer funded Field Schools are much less expensive than those funded by the National Program. The major expenses in the model of the Field School being conducted by the National IPM Program in Indonesia are snacks and compensation for farmers attending the Field School (both less than a dollar per farmer per meeting). At the present a Field School costs about US $200.00 or US $8.00 per farmer (Dilts and Pontius "Lessons Learned from Farmer Field School Programs," Report/Manuscript).

Maintaining Sustainability

To create and maintain a sustainable program is a challenge to program implementers, as well as their beneficiaries. Reviewing the IPM experience, the following points will be useful for consideration:

1. Putting a low external input for sustainable agriculture (LEISA) is a good tool for maintain program sustainability. The cost of the program should be affordable for the program participants. It is important to maintain their ability afford it. Large agricultural programs tend to buy farmers' participation by paying them to come to meetings and by providing lucrative credit incentives and other gimmicks. This approach will not

nourish sustainable agriculture. Rather, an agricultural program should be attractive to farmers because of its values and its ability to benefit farmers by helping them improve their practices and the well being of the farmers. LEISA approach is crucial for any outside intervention to become sustainable. The low external input will keep the cost affordable at the grassroots' level. This is the key to ensuring farmers will continue the practice.

2. A sustainable agricultural program is a program controlled by farmers. Farmers at the end should be able to run the program themselves. Farmer will share with other farmers by developing networks and cooperating with local authorities and government services to provide other farmers with support and technical services. This way advanced farmers become experts to other farmers. The IPM's horizontal dimension spread of knowledge amongst farmers become tremendously powerful. IPM-trained farmers would voluntarily travel to another district to share their IPM knowledge.

3. Empower farmers to become capable of making smart decisions. Smart farmers do not need to be highly educated, but most of the time those farmers who observe well, who can think critically, and can analyze their everyday lives—-are the farmers who will be empowered to make informed decisions. Informed decisions are knowledge-based decisions and can be exercised by anyone who diligently collects the information through research and observations.

4. Open the path to farmers' research and innovations. The IPM program shows that farmers are capable of conducting research. Farmers' research is important for agricultural sustainability. The changing situations demand different approaches and different answers for solving problems. Farmers' research and innovations would help farmers in meeting the challenge of change.

Conclusion and recommendations

To conclude this dissertation I think it is important to recognize that closure summary to all of this is a mere emphasis of the writer point of view on a certain aspects of this dissertation as more or most important. Readers might have seen it differently or even argue in a different way. Putting a conclusion and recommendation to a work this big is a real challenge, as it will put a few aspects on the stage and hide some others which might have equal important. Recognizing all of this limitation I humbly suggest the following points as my conclusion and recommendation.

The Conclusions

Indigenous knowledge (IK) and sustainability framework have always gone hand in hand and have almost become a unity. It was the indigenous knowledge that helped farmers and many indigenous communities around the world to sustain themselves for centuries. Traditional agriculture has maintained a close connection between IK and sustainability. It is simply unimaginable for an indigenous farming community to sustain or survive when separated from their Indigenous Knowledge. Therefore, IK, traditional agriculture, and sustainability of many indigenous communities form an inseparable unity, a synergistic whole that has helped such community to survive almost total threats to their food supply.

IPM, in reality, had played the important role as a link to the revival of the traditional agriculture. It helped bring back IK to life at the same time. The interviewed farmers explicitly noted IPM's contribution to their economic wellbeing, their socio-cultural revival. They clearly understood and appreciated IPM's contribution to the halting of environmental degradation. Through the agro-ecological approach of FFS/IPM training IPM opened the window to the kind of critical thinking that led to the revival of traditional agriculture and the reinvention of IK. One may assent that in general IPM has become the significant factor in contributing to the sustainability of agriculture. It is safe to say that through IPM and the reinvention of Indonesian indigenous knowledge and environmental health entered a new and hopeful era.

Recommendations

Suggesting recommendations for a large society is somewhat presumptuous and always rather tricky.

A. To the IPM farmers my suggestion is to keep up their good work. For non-IPM farmers, maybe it is about time to find out about the IPM farming practices. Talk to the IPM farmers and find out how and why the IPM farmers are better off and could enjoy a happier life.

B. For farmer researchers like Pak Murdjiyo, Mbah Slamet and Mbah Suko, they should find ways to keep their fine programs running. They can listen to other fellow farmers about problems they encounter in the field. They might also develop some ideas and trials to solve agricultural problems. If the new problems arise, farmer-researchers should be ready to integrate them into their research program. The likelihood for finding solutions for local problems will be great and their solutions extended to other farmers. They should also work to find and train their successors who will continue their leadership

C. Other suggestions are for the government of Indonesia, specifically the Department of Agriculture. Farmers need to be supported with policy that will benefit them. Government could provide supportive measures to farmers' activities. The following recommendations are based in part on my assessment of the DOA/I initiative "Go Organic by 2010."

1. Set up policy that will encourage farmers to boost food crop productions while meeting safety standards. They must educate the public and reassured consumers that their food are safe to eat (food safety attributes), posses high nutritional values (nutritional attributes), and are environmentally friendly (eco-labeling attributes). DOA/I need to mobilize their resources to help farmers meet all of the above educational goals. Farmers will intuitively respond to market demands as this will financially benefit the farmers. Good policy setup will become the best incentive for farmers. Market-driven demands will

provide incentives for farmers to increase and improve the quality of their produce. This will guarantee a steady and reliable income to farmers.

2. Department of Agriculture Indonesia must provide guidance to farmers so they can perform at their best. It can explain to farmers about the true incentives of market dynamics: the better they perform, the more financial reward farmers will receive. True incentives farmers will receive from providing good quality products. DOA/I should stop using extension top-down approach when dealing with farmers. DOA/I should be able to use the existing IPM farmers' network and organizations to achieve widespread, effective results.

3. The government should mobilize agricultural and non-agricultural agencies to help farmers meet the market challenge. Government laboratories can help solve some of the problems farmers cannot solve. These laboratories for example provide *Beuvaria bassiana* (Bb) inoculation to start farmers' initial stock of Bb when farmers need it. Inoculation must be prompt, because Bb contaminated brown plant hopper (BPH) will only be found after the initial attack. By that time it will be too late to control BPH using *Beuvaria bassiana*. The labs could keep last year's stock of Bb refrigerated for prompt use and thus save farmers' crops.

4. Guarantee farmers a fair price for their produce. Fair prices have always been the farmers' best market reward. Fair prices will also become farmers' incentive to produce more and better food. By paying fair price consumers will enjoy continuous supply of produce they like, which is safe, nutritious and grown in environmentally friendly conditions. In other words, consumers' willingness to paying fair price will pay a good reward to farmers for their quality work in organic agriculture.
5. Educate consumers about healthy and sustainable agricultural products. Educated consumers are the best buyers of the healthy food produced using alternative farming practices. Initially, the price they pay would be higher, but later when more consumers buy these healthy products and when more farmers produce them, and then the market will come to equilibrium: consumers too will pay a fair price for the quality food they purchase. Educated consumers will also educate others to appreciate the values they enjoy and keep and which the farmers want to maintain and promote.

Based on the examples of success presented above I believe these suggestions are practical and realistic.

APPENDIX A

DISSERTATION STUDY QUESTIONNAIRES

Note: these questions are specially designed for 3 selected advanced farmers who experienced the periods of traditional agriculture, the Green Revolution period (1968 onward), the IPM period (1986 onward) and are now pushing toward Organic Farming

Questions for All

Living Experiences

1. Brief biography: Please ask the following
   a. Where is your place of birth?
   b. How old are you?
   c. How many family members are assisting you in agriculture activities?
   d. Is there any other profession besides farming, and if so what is that?
   e. How is this profession being conducted: simultaneously with farming, before farming or how do you do in relation to your farming profession?
   f. What made you go into farming profession?
   g. Please name three important or significant experiences that touched you deeply that become influential in your life that relate to you as a farmer now; and please explain how that affected you?
   h. Do these experiences still influence you in your farming activities now?

Types and Techniques of Farming

2. Were you already a farmer before BIMAS (Green Revolution) introduced in 1968?
3. What kind of farming did you practice in pre-BIMAS time?
4. When BIMAS was introduced in 1968 and became a national agricultural program, what was your first reaction to the methods and techniques of the new farming system? Did you voluntarily participate, or you found rather difficult to join in the program?
5. When did you realize that the BIMAS program was not a match for you? Did you feel it alone or other farmers around you also felt the same?
6. What particular event or experience that brought you to this new level of awareness?
7. Since when did you practice and develop alternative farming away from BIMAS?
8. What are the major alternative agriculture systems you have conducted, i.e.:
    a. Propagation of local seeds
    b. Fish rearing combined with rice cropping
    c. Integrated pest management (IPM)
    d. Organic farming system
    e. Use of farming calendar
    f. Development and use of natural agents
    g. Direct seeding planting technique (no transplantation of seedlings)
    h. Use of green manure
    i. Use of liquid fertilizer
    j. Use of fermented cow urine as fertilizer
    k. Use of fermented molasses from sugar factories as fertilizer
    l. Use of natural pesticides like Neem, Brotowali (bitter-plant), bitter ieaves, and beetle nut

m. Use of natural insect repellent like Marigold flowers or companion planting with other plants

n. Pest-control using fungi like *beauvaria bassiana, trichogramma sp.*

9. Please explain ingredients and techniques used in homemade, natural-pesticides. How do you apply them in the field (techniques and steps to produce natural pesticides, liquid and green manure, and pesticide made from micro-organism)?
10. Please explain advantages of alternatives such as natural farming practices; and how effective they are in achieving your goals? Please explain, if applicable, unwanted or negative impacts from using these methods.
11. What is the cost to install and conduct this alternative farming system? Please explain the cost of producing and applying each natural ingredient you use for pesticides or fertilizers.
12. What is the comparative cost of the techniques recommended by BIMAS versus the cost of the alternative farming method you apply now in order to achieve the same goal? For instance, factory made liquid fertilizer cost ID Rp 40.000/liter. What would it cost to you to make a comparable homemade product?
13. Please describe optimum results achieved with alternative farming in term of efficiency for pest control and increased crop yields.
14. Besides the increased crop yields, are there other benefits derived from these alternatives farming practices (i.e. farmers' health, environment, family income, personal satisfaction) when compared to BIMAS farming practices?
15. Are there BIMAS farming practices still in effect besides the alternative farming systems you currently apply? If so, please describe the BIMAS practices still being utilized.
16. Do you use chemicals or manufactured inorganic products at all? If so, which product and what is the application dose? Please explain why are you still using it?

17. What is your opinion on BIMAS farming system recommended to Indonesian farmers now?
    a. Is it great and benefiting for most farmers in Indonesia;
    b. Is it good but not really needed;
    c. Is it uneconomical because it is expensive
    d. You opposed to BIMAS, because it is costly to farmers and damaging to the environment.
18. Do you do a cost/benefit analysis of farming activities? To your calculation: the cost of alternative farming systems versus BIMAS farming, which is better or more profitable? Please illustrate.
19. Of the alternative farming systems (Non-BIMAS), are there any traditional practices revived from by the community from the previous generation?
20. Please describe alternative-farming systems based on indigenous knowledge or knowledge of ancestors (for instance: mentioned in earlier interview about the use of traditional farming calendar, techniques to controlling rice ear-bug or *walang sangit* and so on).
    a. Are there any modifications or changes applied to improve these traditional practices?
    b. If so, what modifications or improvements have been done?
    c. And why are modifications of traditional methods necessary and or important?
    d. How effectively did the modifications impact in the farming results?
21. Please list the following order:
    a. Traditional methods or practices revived
    b. Modifications for improvement made
    c. Reasons necessitating modification
    d. Level of improvement on results achieved
22. What traditional practices did authority prohibit during the BIMAS period?
23. What was your reaction to this ban?
24. Reflecting on the BIMAS program and farming techniques, in your opinion, did these practices cause financial loss (economy), personal health

problems (yourself and your family), cause harm to domestic animal, environmental damages (social cost to communities)? Please describe damages caused by each BIMAS practices.

Integrated Pest Management (IPM) Farmer

25. When did you learn about and join IPM? When did you start IPM training?
26. Do you see differences in the IPM approach versus the BIMAS approach? If so, please explain?
27. Do you have confidence in the IPM approach? If so, why?
28. What do you see as substantial differences between BIMAS and IPM approaches?
29. Are you a farmer's trainer?
30. How many times a year do you conduct your own training or are you invited to IPM training as guest trainer?
31. If invited as speaker at IPM training; are you paid or do you volunteer? If you volunteer, what motivates you to continue volunteering for IPM training?

Learning and Teaching Activities

32. Do you perform activities to facilitate and train others about alternative farming systems you developed? If so, name of activities (for example, conduct training, shared ideas in the meetings, word of mouth or discussions with neighbor farmers, or presentations at local, regional or national seminar forums).
33. Have you ever been invited to carry out the training? If so, who or which group have invited you?
34. What was the reason for inviting you to conduct training at that forum?
35. Who were the participants you trained: Groups of farmers, students, University students, female farmers?
36. What were the participants' reactions and responses to alternative farming systems you presented?

37. Where did you initially learn of the basic ideas of alternative farming systems? Was it from the national program of IPM, extension agents, the wisdom of the elderly or your ancestor, a seminar/workshop/farmers meeting, knowledge exchange with other farmers, etc? What were your original ideas?
38. Do these alternative systems require improvements? If so, what kinds of improvements are needed?
39. Did you conduct research or make observations in order to improve on these alternative systems? What specific research did you execute to improve results and effectiveness of alternative systems you developed?
40. Did you conduct small-scale experiments to evaluate results before fully implementing into your farming activities?
41. Do you believe alternative farming systems need to be supported and further developed? If so, which supports are needed? Which way this system need further development?

Training and Dissemination of Ideas and Skills to other farmers:

42. Are you an official farmer trainer now or recognized by other to training other farmers?
43. Among farmers in your village, are you considered as expert farmer whom others often come and ask questions and chat about agricultural problems they have?
44. Do you have experience in conducting farmers' training outside of your home village? If so, please mention.
45. Have you ever been invited to conduct farmer group training? If so why? Is it because of your success story in agriculture business?
46. Have you ever been invited to talk about farming outside farming communities? Which groups has invited you to talk?

Training and Spreading of IPM farming Techniques to the women farmer groups:

47. Have you ever conducted any training for women farmer? Or your training is always open for both male and female farmers?
48. What is the response level of the female farmers about the IPM or natural farming techniques, when compared to BIMAS methods?
49. Are female farmers more enthusiastic and responsive than male farmers? In what way female farmers more or less enthusiastic or responsive?
50. Please explain why?

Involvement in Farmer's Science Workshop:

51. Do you play an active role participating in the farmers' science workshops?
52. Do you routinely participate in these workshops, or just come once or twice?
53. Do you feel the process of learning in these science workshops is good (or not good)? Please elaborate more.
54. Have you ever presented any of your own innovations or ideas, from your experience at the meeting? What innovative idea you presented in the meeting?
55. How was the response of participants on your presentation?
56. Up to now how many innovations or ideas have you presented at the farmers' science workshops?

Involvement in National IPM Farmer Association

57. Do you involve in the creation and foundation of National IPM Farmers Association?
58. Did you attend the big meeting among IPM farmers in Yogyakarta? And with the Minister of agriculture in 1999?

59. Do you think the main goals and the roles of National IPM Farmers Association in line of, support IPM methods, and promote nature friendly agriculture?
60. Do you think the role of National IPM Farmers Association in the future as defender of IPM and ecological farming will function well?

Questions for Mbah Suko in Magelang:
Propagation of Local Rice Seeds:

1. Which local rice varieties have you propagated? Please list their names.
2. Compared to the IRRI rice from the BIMAS program, what are the general characteristics of the local rice?
    a. Seed size
    b. Taste characteristics (smells good and good-tasting)
    c. Plant height
    d. Growing time until harvest
    e. Need for special pests protection
    f. Fertilizing crop/soil
    g. Average yield/hectare (or other measurement)
    h. Specific harvesting methods or transport of harvest from the field to home needed?
    i. Grain loss from panicles during transportation from field to home? Estimated percentage of grain loss from the field to storage by best guess.
3. How do you promote the planting of local or heirloom seeds? If local seed is sold, does it cost the same as the BIMAS seed (blue-seed) or is it cheaper or more expensive?
4. What variety of local seeds are you currently propagating?
5. Please name of local rice varieties preferred by farmers due to the following factors: high yields, good-taste, higher selling price and grain retention in panicles during transport.

6. Are certain local rice varieties disliked by farmers, for the following reason:
    a. Long growing time
    b. Low pest resistance
    c. Lower yields
    d. Less aromatic flavor

Combined Rice Cropping and Fish Rearing

7. What is your main reason for combined rice cropping and fish rearing?
8. Are many people in your village combining rice cropping with fish rearing?
9. What do you feed the fish you raise in your paddy field?
10. Is combined rice cropping and fish rearing of local rice fields better or worse than BIMAS rice fields?
11. How much extra income do you get from sales of fish, or do you raise fish only for family consumption?
12. Have you experienced fish poisoning from pesticides used in neighboring rice fields? If so, how did you overcome this problem?

Production of Natural Agent for Fertilizers and Pesticides

13. What kind of natural agent you often made at home (both natural pesticide and natural fertilizer)?
14. Are these homemade natural agents sufficiently good, good or excellent?
15. What is the cost for producing these natural agents?
16. Are these natural agents become popular among farmers in the surrounding community? Alternatively, maybe it becomes even more popular in other villages or other areas.
17. For comparison, money spent for buying factory made chemicals to the cost spent for producing natural ingredients at home. How much money could you save?

18. Do you take notes during the production process, that way you recorded the making process of the home products. The formulas you made are kept only for yourself or they are also shared among friends.
19. If you share your formula to others how would you do it?

Questions for Pak Murdjiyo in Paten, Sumber Agung, Jetis, Bantul:

Production of Natural Agent for Fertilizers and Pesticides

20. What kind of natural agent you often made at home (both natural pesticide and natural fertilizer)?
21. Are these homemade natural agents sufficiently good, good or excellent?
22. What is the cost for producing these natural agents?
23. Are these natural agents become popular among farmers in the surrounding community? Alternatively, maybe it becomes even more popular in other villages or other areas.
24. For comparison, money spent for buying factory made chemicals to the cost spent for producing natural ingredients at home. How much money could you save?
25. Do you take notes during the production process, that way you recorded the making process of the home products. The formulas you made are kept only for yourself or they are also shared among friends.
26. If you share your formula to others how would you do it?

Use of Fungi as Natural Agent for Pesticides

1. Please describe production process of certain fungus, which can be used for pest control? What is the name of these fungi?
2. What are the benefits of using these fungi?
3. What is the process of the making of the fungi or bacteria for natural pesticides?
4. What are the factors that can cause failures, and how to prevent it?

5. Do you sell the fungi as natural pesticides you produce? If for sale, how well is the sale? Do you think the use of fungi for natural pesticides might become popular in the future?

Neem as Natural Agent for Pesticide

6. Is Neem (local: *Nimba*) is a native crop in this place or imported in from other places or other country?
7. Is there any native or Indonesian name for the crop?
8. Is the Neem a tree, bush or a clump?
9. Neem is derived from a part of a tree; please describe the processing of that part (seed, stalk, root, leaf etc) to render it material ready for application or for sale.

Bitter Plant (local: *Brotowali*)

10. What is the name of Brotowali in Indonesian or in other local languages?
11. Is Brotowali for pesticide is the same species that is used for making tonics or for herbal medicine?
12. Please describe production process of Brotowali to become pest repellent or pesticide ready for use.
13. How effective is the Brotowali as plant protection or pest repellent.

Marigold (local: *Kenikir*)

14. How do you use Marigold as pest repellent?
15. Besides growing Marigold intercropped by planting in the dike in the rice fields, is Marigold also good for the ingredient for making natural pest repellent?
16. How effective Marigold in repelling pests?

Improving Yields of Groundnut by Pushing the Stems to the Ground

17. Please describe how you apply this practice used to increase profitable groundnut production.

18. How much increase in yields do you get using this “pushing down the stem” technique on your groundnut production?

Questions for Mbah Slamet in Kedung Agung:

IPM and Environmental impacts to cattle Health

1. When did you join the IPM?
2. What made you join the IPM training?
3. You mentioned about a number of cases of cattle poisoning when you were working as government veterinarian. Please elaborate more on this.
4. Do you find IPM farming practices friendly to our environment?
5. If farmers can feed their rice residues from after harvest to their cattle without poisoning them, how much savings would farmers who own cattle or small ruminants would enjoy?
6. Do you think many farmers will easily understand that chemical pesticides sprayed on rice will not only affect the cattle and small ruminant animals when they eat the rice residue, but also to human who eat the rice grains?

On Javanese Indigenous Farming Calendar

7. What is indigenous farming calendar (local: Pranoto Mongso)?
8. What are the main issues addressed in the instruction or direction suggested in this farming calendar?
9. Do you think farmers were commonly use Indigenous farming calendar before the introduction of BIMAS program in 1968?
10. What are the main benefits of using indigenous farming calendar in farming practices?
11. What are disadvantages of using this indigenous farming calendar if any?
12. During BIMAS program, are there farmers still using and practicing indigenous farming calendar? Is this issues were commonly discussed among farmers during BIMAS period? Were these traditional farming calendar allowed to be implemented during the BIMAS period?

13. Do you think with IPM, farmers will again guide their farming practices using indigenous farming calendar?
14. Will the indigenous wisdom claimed in this calendar withstand the agro-ecological system analysis introduced by the IPM farming practice? Do you think both of could go together?

APPENDIX B

LESSONS LEARNED FROM FARMER FIELD SCHOOL PROGRAMS

A Reflection written by Russ D. Dilts and John Pontius

The following are lessons which in a sense summarize nine years of experience. To point out every lesson learned during that experience would be a bit overwhelming. Instead, the following is a short list, a “top ten”, of lessons which deserve emphasis. The lessons range from those that are more philosophical in nature to those that are operational.

1. Have Values and Be Clear about Those Values

What fundamental value drives IPM activities in Indonesia? IPM training activities do not focus on insects alone they also provide farmers the opportunity to leam and eventually achieve greater control over the conditions which they face at the field level. As such, empowerment, a fundamental element in a civil society, is the value that has influenced the design and implementation of IPM activities in Indonesia. Training design and program management has intentionally taken a direction that provides farmers the opportunity to develop their own potential. Community IPM is based on empowerment.

Why empowerment? Farmers live and work in a world where they face a variety of contending forces including those related to: technology, politics, markets, and society. These forces tend to marginalize farmers.

There are contending technologies presented to farmers. These technologies were developed, ultimately, not with the goal of increasing profits for farmers; the goal was increased profits for those who developed the technologies. Farmers need to be able to select from these technologies those which would most benefit them. A farmer must also be able to transform and evolve any chosen technology in the context of the ecological and market conditions faced by that farmer.

There are political pressures on farmers, from the village level to the national level. These pressures, although it is often claimed otherwise, do not always have the farmers’ best interests at heart. Farmers need to be able to understand and act within these forces to guarantee that their interests are served.

2. Farmers Can Train Other Farmers

Experience clearly demonstrates that farmers can be capable trainers and program organizers. There are several reasons why alumni can successfully implement Field Schools:

- The approach is easily replicable by anyone who experiences it and can learn, not to be a teacher, but a Field School leader.

  The Field School approach allows farmers to master learning methods as the methods, such a field observations, dialogues, questioning, special topics, are continuously repeated during a Field School.

  Leadership skills are important to the quality of a Field School and these can be trained and modeled by PHPs.
- The basic technical issues related to field ecology are mastered by farmers in Field Schools. Required additional technical background can be trained.
- Farmers have no problems in relating to other farmers, especially in their own village.

The following are important lessons that have been learned regarding Farmer IPM Trainers:

1. The key issue is motivation. Alumni who are highly motivated will learn what they need to learn in order to successfully conduct an FFS. Without motivation they might find conducting an FFS as well as learning about technical issues to be too difficult. Thus selection criteria should focus on motivation first.
2. The TOT for Farmer IPM Trainers in Indonesian is heavily weighted on the side of leadership training. This also helps them as community IPM organizers. Leadership training includes facilitation skills, planning, and management. Farmers practice these skills in the TOT.
3. Farmer IPM Trainers report that, while a five to seven day TOT provides them enough time to learn what is needed to conduct an FFS, they would like to have more training. In Indonesia, Farmer IPM Trainers Technical Workshops were instituted for the purpose of providing additional training when it is most needed, as Farmer IPM Trainers are conducting Field Schools. These workshops provide additional training in special topics activities.
4. The management and technical support provided to Farmer IPM Trainers is also important. PHP visit a Field School conducted by a Farmer IPM Trainer several times during a season. The visit is meant to help the trainer critique his or her work. The PHP also uses these visits to provide any additional technical information that the trainer may want.

3. Farmers are Effective Organizers

- Villages where Farmer IPM Trainers live tend to have far more active IPM programs than villages without Farmer IPM Trainers. The informal spread effect of IPM tends to be broader in villages where Farmer IPM Trainers live.
- IPM Sub-districts with greater numbers of Farmer IPM Trainers tend to have stronger IPM programs.

In over 95 % of the 183 IPM Sub-districts for which there is data, alumni have either organized an IPM based organization or they have re-organized their Farmers Group or Water Users Association to serve as a forum for IPM issues.

IPM farmers are organizing collaborative projects throughout project provinces. Whether the projects focus on pest control, credit for farmers, seedling production, business enterprises, or promoting IPM, IPM alumni have been able to effectively collaborate with government officials and other farmers to enhance their control over the conditions that affect their livelihoods. These farmers are organizing activities with the support of local government. Rather than posing a threat to local government, IPM alumni are recognized by local officials as contributing to the enhancement of village and sub-district economic development.

The training for Farmer IPM Trainers includes management of Field Schools, leadership, planning, and social dynamics. Farmer IPM Trainers also make use of these skills as they organize their projects. The critical thinking skills that they have acquired not only help them in problem analysis, but also in their project planning.

4. Farmers can do Science

In 183 sub-districts IPM alumni pre funding and conducting their own field research. These studies help alumni increase their understanding of the ecology of the agroecosystems in which they work. Studies conducted by farmers focus on a variety of issues including: ecology, agronomy, varietal selection, varietal development, and non-pesticide control methods. Studies have resulted in the development of technologies which alumni judge to be appropriate to their needs as IPM farmers. These technologies include control methods for rice stemborers, golden snails, rice seed bugs, and rats.

I PM alumni are conducting research on their own initiative. They have learned how to learn from research. They are not field research workers employed by university staff. They develop their own research questions, conduct their own studies, make their own analyses, and take steps to share their knowledge with other farmers via the organizations that they have created. When help is required to design a study or analyze its results, alumni consult with PHPs.

5. Farmers can Effect Policy Change

Well organized Field School alumni who understand ecology, think critically, and possess the relevant data can change local policies. Farmers are changing local policy across the country.

The District Head of one of the largest rice producing districts in Indonesia, Indramayu, has enacted as district policy a non-pesticide approach to rice stem-borer control developed by alumni. The stem-borer problem is endemic to Indramayu. Pesticides were always thought to be the only possible control for the insect. Based on their research results alumni developed a control method that proved effective. Alumni then organized several seminars that impressed the agriculture service of the district and ultimately the district head. Once the policy was in place alumni organized farmers across the district so that the control method would be effectively applied. As a result, in a district where an estimated 25,000 hectares suffered heavy damage due to rice stemborer during the previous main cropping season, there was virtually zero crop loss after the policy was put in place. Virtually the same type of process took place recently in a subdistrict of Brebes District on the north coast of Central Java.

While not as startling but equally as important, alumni throughout project provinces have been able to effect policy change concerning the use of local government development budgets and the exclusion of pesticides from Village Cooperative Unit credit packages. Good organization, having the facts at hand, and clear presentation of those facts seem to be the primary reason that farmers have been able to successfully change local policy.

6. There is a Spread Effect.

The cases demonstrate that a spread effect exists because of IPM training. IPM trained farmers talk to other farmers about what they learn in Field Schools. Alumni and Farmer IPM Trainers organize activities to help other farmers learn about IPM. Field studies are used by farmers to demonstrate IPM principles. Alumni organize and re-activate Farmers Groups to provide forums for IPM trained farmers to help others learn about IPM. One reason alumni are committed to teaching others about IPM is that they realize that for IPM to most effective it should be applied on a hamparan-wide scale. The cases have documented how religious or cultural tenets also motivate alumni to spread IPM among friends and neighbors.

There are several reasons why the Field School approach encourages a spread effect.

1. Alumni master Field School methods because of the frequent repetition of activities and processes. This means that alumni can use many Field School learning methods to teach other farmers. (For example, insect zoos, field studies, or field observations)
2. FFS activities are not dependent on materials that are centrally produced; they are dependent on a process and on farmers producing their own materials. Thus informal approaches by alumni to other farmers are not limited by lack of materials; alumni can produce what they need.
3. The discussion, presentation, and dialogic skills learned by alumni during the FFS can be used by alumni to help others learn about IPM.

7. Intensity of Activities is Important

"Intensity of activities" means both the actual number of Field Schools conducted in a village as well as the follow-up to those activities. A single IPM-trained farmer faces a tremendous amount of peer group pressure to use pesticides. For a generation farmers have been told that using pesticides insures good yields. Non-I, PM trained farmers will pressure alumni in a variety of ways to use pesticides because of their fear over toss of yield to insect pests. The more alumni in a village, the more support there is for an individual farmer to apply IPM principles. The more Field Schools in a location, the greater the likelihood that there will be higher numbers of Farmer IPM Trainers in that location. As stated earlier, villages and sub-districts with higher numbers of Farmer IPM Trainers tend to have more active local level IPM programs.

The Farmer Planning Meeting and the Farmer Technical Meeting appear to be key activities in furthering the development of community IPM programs.
Farmer Planning Meetings:

- are a forum where alumni from different villages get to know each other and leam about what they have in common as IPM alumni hence a network develops;
- provide alumni from villages across one sub-district the opportunity to develop village IPM program plans and coordinate implementation of program plans on a sub-district scale;

Farmer Technical Meetings:

- are a forum where alumni leam about the results of activities conducted in other villages in their sub-district, they motivate alumni to try new ideas;
- provide alumni the chance to discover the importance of sharing information across a sub-district;
- Help alumni improve their own village level IPM activities based on the experiences of alumni in other villages.

Together the meetings help farmers to conceive of programs that are larger than their own hamparan or village. Alumni develop a sense of sharing common goals and hence a desire to continue these forums. These meetings provide the first opportunity for alumni to work together at a sub-district level and often provide the motivation for alumni to establish their own IPM forums. These or similar forums are a necessary element in the establishment of successful IPM Sub-districts.

There are two important points regarding the conduct of these IPM forums.

- There are usually two to three rounds of these meetings in a single sub-district.
- While the PHP plays a major role during the first round, Farmer IPM Trainers perform many of the tasks so that they leam how to plan and conduct the meetings. During the second round Farmer IPM Trainers take over the role played by the PHP.

8. Pesticides are Not a Production Factor

The analysis of farmer's practices in the cases suggests that pesticides are not a factor of production in rice. Using pesticides does not guarantee a higher yield. Lack of pesticides does not guarantee a lower yield. All accumulated experience shows that not using pesticides coupled with using good agronomic practices increases the likelihood of higher yields. A speculation might be added. Pesticides actually contribute to yield loss. This is obvious when there are major outbreaks resulting from pesticide use. The suggestion is that in an average season, without a major outbreak, the average rice farmer using pesticides, all other things being equal, will actually lower his or her yields because natural enemies will not be around to clean up the damage that pesticides do to the agroecosystem. Natural enemies are a much more effective control for pests in rice than pesticides. Results from studies in Vietnam and the Philippines and other studies from Indonesia add further support to this contention.

9. Field Schools are Cost Effective

The target for costs per farmer trained in a rice FFS is US $10.00. Since 1990, the costs have fluctuated above and below that figure. Farmer funded Field Schools are much less expensive than those funded by the National Program. The major expenses in the model of the Field School being conducted by the National IPM Program in Indonesia are snacks and compensation for farmers attending the Field School (both less than a dollar per farmer per meeting). At the present a Field School costs about US $200.00 or US $8.00 per farmer. The economic data in the cases and in the data presented in the Annex suggest that this cost is covered by the increases in alumni incomes the season following training. The horizon of benefits resulting from training continues for more than one season into the future. There appears to be no ground for criticism of the Field School approach based on its costs.

The horizon of benefits from IPM training exists for several years into the future not only because alumni can be expected to continue farming for at least several more years, but also because they can:

- conduct field studies to expand their understanding of field ecology;
- effectively evaluate and employ available technologies;
- effectively manage their agroecosystems;
- organize changes which impact large numbers of farmers.

This notion of a horizon of benefit flows continuing into the future is important. First and foremost these benefits flow directly to farmers. The nation also benefits because of the increased stability of rice production. Secondly, these benefits, as demonstrated in the cases, increase over time as more farmers begin to apply IPM principles because of what they have learned from alumni-led community IPM programs. Not only do the numbers of farmers applying IPM expand, those applying IPM also get more effective at doing so. Thirdly, community IPM activities are not limited to crop production alone. Alumni are establishing credit programs, input cooperatives, and marketing projects. Marketing projects include pesticide-free rice projects. Thus the benefit stream is not only widening, it is also deepening.

This lesson should be of interest to those who would support a social marketing scheme, the advertising of one message continuously to change pesticide use patterns. Such a project may be cheap at the outset, but it produces no social benefits and a very limited stream of economic benefits. In addition, because of the "noise" in the field, for example, the marketing of products by companies, the message must be repeated in different ways in different media to continue to have any effect over lime. A social marketing project has a cost that is continuous and in the end, not so cheap.

10. There is an Obligation to Follow-up

A striking result of Field Schools is the follow-up conducted by alumni themselves. Field School alumni, on their own initiative, begin to:

- Try to increase the number of farmers implementing IPM. Whether at the mosque, the subak, or after a wedding, alumni talk to other farmers about IPM;
- Take action to improve or re-organize their Farmers Groups to enhance the spread of IPM;
- Conduct their own field studies to leam more about field ecology and agronomic practices.

Community IPM is thus an obligation for a program committed to equity. There is an obligation to follow-up Field Schools with activities that will help farmers increase their understanding of field ecology as well as organize their own local IPM programs. Alumni have demonstrated that they will make every effort to optimize any follow-up provided to them. Field Schools open the door to a wide variety of opportunities for alumni. To not follow-up Field Schools with activities that insure that the opportunity is taken advantage of might well cause the door to close.

APPENDIX C

KNOWLEDGE FROM THE FIELDS: A MINI CATALOG OF INDIGENOUS KNOWLEDGE AND FARMERS INNOVATIONS

This appendix section consists of a compilation of indigenous agricultural practices I have collected from farmers' notes, farmers' science meetings publications, interviews, and other local oral "literatures". The purpose for this appendix section is to catalog some of indigenous agricultural practices that were commonly found during pre-green-revolution era then reinvented and put back into practice as is or with some modifications to improve their efficiency in achieving better results. Some of these practices were innovations done by farmers, inspired by traditional wisdom and through adaptation of universal knowledge farmers learned from research centers or university communities. Creatively they have made them adaptive and available to local farmers' knowledge. This reinvented knowledge is familiar to local farmers and friendly to their environments.

This collection of agricultural practices will serve as means for sharing the communal indigenous knowledge and their derivatives so this will go on records and be shared and spread further to various farming communities. This way, also, some of the notes might reach out globally to many indigenous farming communities from around the world and they too would enjoy and share the benefits from this knowledge. Each of this practice is structured in the following sequence:

1. Name Or Title Of Practice/Project
2. The Purpose or Beneficial Uses
3. What Are The Materials Or Ingredients Needed
4. How To Prepare The Ingredient Or The Formula
5. How To Apply It
6. How Does It Work
7. Important Notes Or Cautions:
8. Sources of Information

The List of Practices:
1. Marigold Repels Bugs
2. Sweet Basil To Attract Fruit Flies
3. Baiting Rice Seed Bugs
4. Spiders Farm
5. Dragonfly in the Rice fields to control BPH
6. Rice cropping combined with Fish Rearing
7. Homemade liquid fertilizer

Marigold Repels Bugs

Marigold has been known to have insect repellent capacity especially for aphids and trips. Farmers use Marigold as companion planting.

Name or Title of Practice/Project

Have marigold plant around and among crops to repel unwanted bugs and pests.

The Purpose

Marigold, an annual flowery plant is known worldwide for its capacity in repelling unwanted insects and pests that could damage the crops.

Materials or Ingredients Needed

Marigold seeds save from last year planting.

How to Do it

This practice is very simple. All needed is to plant marigold as companion plant to the crop that would suffer from aphids and trips attack. Marigold can be planted in between rows, along the edges near the crop.

How to Apply

Marigold as companion plant repels some small bug like aphids and trips. In Central Java these bugs are the major pest for chili peppers (capsicum family). Aphids and trips cause leaf blight and curling of the leaves causing the slow growth or died plants.

How Does It Work

Marigold functions as insect repellent and scare pathogenic insects from coming and attack the main crop.

Important Notes or Cautions:

Keep Marigold planted with a little distance from the crop so they do not compete with one another.

Sources of Information

1. Pak Murdjiyo own farming practice in Bantul, Yogyakarta, Indonesia.
2. Companion planting, please see Appendix D

Sweet Basil attracts Fruit flies

Using similar concept of companion planting, growing sweet basil near mango tree (Mangifera Indica) would attract fruit flies to the flowering Sweet Basil (Ocimum basilicum L.) and left the mango flower undisturbed. Fruit flies known to cause damage to mango, as they lay eggs in the mango flowers and ruin the mango fruit. Having sweet basil near mango would save the mango from fruit flies attacks. So like the Marigold repels aphids and trips, Sweet Basil attracts fruit flies.

Baiting the Rice Ear Bug

The Rice Ear Bug, *Leptocorisa oratorius*, damages the flowers and milky grains of the rice plant, and can lead to huge losses. Traditionally, farmers put out bait to attract the bugs so that they could then be killed. However, these traditional methods have been neglected in the move to modernize agriculture (Ooi, 1998).

Name or Title of Practice/Project
Baiting rice ear bugs (*Leptocorisa oratorius*).

The Purpose or Beneficial Uses
Attract bad insect to a trap place around the rice field so they can be destroyed by burning.

Materials or Ingredients Needed
1. cheap traps using 1.5 litre drinking water bottles
2. Animal-based lures to attract the Rice Ear Bug. Useful lures included putrescent crabs, putrescent toads, putrescent prawn or prawn paste, droppings of chicken and decaying chicken intestines.

How to Prepare the Ingredient
1. Put the lures in used 1.5 liters drinking water bottles.
2. Traps made from old water bottles were tied to bamboo poles about 2m high. When sunk into the mud, the trap stood just above the flowering parts of the rice plant.
3. Place the traps in and around the rice field

How Does It Work
1. Rice Ear Bug attracted to smelly substance originated from decaying bait made from chicken dropping, putrescent prawn or prawn paste, and putrescent internal organs of chicken. Rice Ear Bugs will fly in to the bottle and got trap there. The big base and small mouth design of the bottle made the bugs stay in the bottle and can not leave the bottle.
2. Bottles can be collected everyday and emptied out. The trapped Rice Ear Bugs can be collected and killed, usually by burning.
3. After putting new bait, the bottles can be replaced in the rice field again.

Important Notes or Cautions:

IPM farmers in the village of Sambon in Central Java, who conducted this experiment facilitated with the help of IPM facilitator from the FAO Technical Support Team. From the data collected, it showed that about 92-100% of Rice Ear Bugs trapped during this experiments are male Rice Ear Bugs, only few are female (less than 10%). Chicken dropping proved to be the best lure for this trap with over 200 Rice Ear Bugs a day during the peak season. Decaying crab was less with about 100 catches a day during the same time period. Chicken intestine is the least attractive to Rice Ear Bugs as it attracted less than 50 bugs during the time period.

The following table shows Sambon's IPM farmer record of their experiment.

Table Analysis of success of traditional baits in trapping *Leptocorisa**

Days after Setting up study**	Treatments																	
	No bait			Rotting crabs			Rotting toads			Fermenting prawns			Chicken droppings			Rotting intestines		
	M	F	% M	M	F	% M	M	F	% M	M	F	% M	M	F	% M	M	F	% M
1	4	0	100	134	1	99.3	7	0	100	19	0	100	235	0	100	13	0	100
2	22	0	100	112	0	100	26	0	100	4	0	100	130	0	100	15	0	100
3	9	0	100	58	2	96.7	54	0	100	11	0	100	200	0	100	48	0	100
4	8	1	88.9	17	2	89.5	19	4	82.6	8	0	100	66	2	97.1	39	2	95.1
5	1	1	50	18	2	90	39	2	95.1	25	1	96.2	56	3	94.9	14	1	93.3
6	7	0	100	15	0	100	12	1	92.3	11	1	91.7	69	0	100	12	1	92.3
7	2	0	100	20	1	95.2	24	3	88.9	18	0	100	17	1	94.4	17	1	94.4
8	1	0	100	28	0	100	11	0	100	9	1	90	58	0	100	41	0	100
9	0	0	0	14	1	93.3	16	1	94.1	11	0	100	49	1	98	14	1	93.3
10	0	0	0	12	0	100	6	2	75	2	0	100	14	0	100	19	2	90.5
Total	54	2	96.4	428	9	97.9	214	13	94.3	118	3	97.5	894	7	99.2	232	8	96.7

* - Total of four (4) replicates
** - Study was started on 6/ii/96
*** - M = Male; F = Female; % M = % of males caught

Sources of Information

1. Ooi, Peter A. C., *Beyond The Farmer Field School: IPM and Empowerment In Indonesia*, a paper presented at the International Conference of IPM - Theory and Practice, Developing Sustainable Agriculture, Guangzhou, China June 15 - 20, 1998. A web article found in the following link: http://www.communityipm.org/docs/Beyond_FFS.doc

Spider Farm

The Purpose

Breeding and propagating spiders in a contained area for release in the rice fields to help control the pests.

Material Needed

Herbarium or small glass aquariums by the size of about 24" X 12" X 12". A used aquarium no longer in used for a crack in the glass pane would be perfect for this purpose.

How to prepare the spider farm

1. Fill in the herbarium with a natural setting suited for the spider living environment. Put some soil with grass and some little twigs in the herbarium. Cover the top with insect screen so the spiders do not jump out of the cage.
2. Find a pair of adult spiders that is ready for mating. Wolf Spider, *Lycosa pseudoannulata* is one of jumping spider of Salticidae family would be the best choice. Jumping spiders do not make web and move around actively to hunt their preys. This type of spiders is the fiercest hunter able to consume about 10 to 15 brown plant-hoppers in a day.
3. Feed spiders with insects collected from the rice fields. Make sure they got enough food in this contained environments.
4. About one week after mating female spider will lay eggs.
5. About one week after that, these eggs will began to hatch. Spiderlings (newly hatched spiders) will live from the yolk sac until they are strong enough to find food on their own.

How to Apply

When these spiderlings reach up juvenile size, then they become quite strong and ready for release in the rice fields. Spread them around well so they do not have to compete for food.

How it works

1. Raising and propagating spiders will improve their chance of multiplication and survival better than their natural environment.
2. Spider farm guarantees sufficient spider population for release in the targeted rice fields.

Important notes or cautions:

1. Until they are mature it is almost impossible to reliably identify spiders to a particular species. This is because differences in the structure of the mating organs in mature spiders are the most important means of species identification. This means if you have a pair that looks alike; it does not guarantee they are from the same species, and therefore would mate.

2. Wolf Spider, *Lycosa pseudoannulata* one of the fiercest hunters among spider species would be a preferable choice. This species is also the most commonly found in the rice fields in Java.
3. Male spiders are usually about the similar size of the female spiders. In some species the male spider are significantly smaller.
4. After mating, male spider usually becomes an easy prey for the female spider unless they make timely sneak-out to save their life after a quite exhaustive mating procedure.
5. A giant female spider could produce more eggs and increase the chance of more young survivals.
6. Spiderlings cluster together initially, still living largely upon the remnants of yolk sac in their abdomens. These spiderlings are cannibalistic after their yolk sac is empty they have to move and spread out so they do not eat one another.
7. Some spiders are dangerous, their venomous bite could kill. This is especially true to a number of Australian spiders.

Sources:

1. Mbah Suko experiment on spider farming, Suko is a farmer leader from the village of Kenteng, Sawangan, Magelang, Central Java, Indonesia. This spider farm was his original idea he shared with other farmers in an IPM farmer's science meeting.

2. Australian Museum Online; A quite extensive discussion on spider mating, available on line via http://www.amonline.net.au/spiders/.

Dragonflies in the Rice Fields to control BPH

Title of Practice/Project

Inviting dragonflies to your rice-fields to protect from BPH attack

The Purpose or Beneficial Uses

Encouraging and inviting dragonflies, a known predator of Brown Plant Hopper (BPH), to your rice fields and make them stay around there.

What Are the Materials or Ingredients Needed

Bamboo sticks a little bit (15 – 30 cm) taller than the maximum height of the rice crop. It is important that these sticks stand taller so they attract the dragonflies to come and rest at those sticks.

How to Prepare the Ingredient or the Formula

Cut bamboo sticks about 1-2 feet taller than the maximum height of the rice crop. Local rice is about 3 feet tall; hybrid rice is about 2 feet tall.

How to Apply It

Plant these bamboo sticks around the rice crop. Make sure that each stick goes deep enough in the soil so it doesn't tilt or fall down.

How Does It Work

Dragonflies are attracted to sharp objects that stand taller than its surrounding. Putting bamboo sticks around the rice crop encourages dragonflies to come and rest at those stick. Dragonflies are known predator of other insects, BPH is one of those insects dragonflies would prey on. Providing bamboo sticks will simply attract dragonflies to come and stay at the rice field.

Important Notes or Cautions:

Some biological control specialists suggested that dragonflies may not be all that important in controlling BPH. While this is probably true, as BPH concentrates near the base of rice plants. The presence of dragonflies will probably remove the arriving and departing BPH adults and encouraging the community to more innovative ways of appreciating biological control (Ooi, 1998).

Sources of Information

Ooi, Peter A. C., *Beyond The Farmer Field School: IPM and Empowerment In Indonesia*, a paper presented at the International Conference of IPM - Theory and Practice, Developing Sustainable Agriculture, Guangzhou, China June 15 - 20, 1998. A web article found in the following link: http://www.communityipm.org/docs/Beyond_FFS.doc

A Dragonfly IPM Story

I found this little story by Peter Ooi, an entomologist from Department of Agriculture, Malaysia, very interesting. This story is taken from his paper mentioned above. I think this a very good illustration of one IPM practice supports more IPM related practices among the farming communities. Enjoy the story.

> Pak Oyo is a respected farmer in his community and attended a Farmer Field School two years ago. At the FFS he learnt about natural enemies that keep rice herbivores in check (Ooi, 1996). Following field observations and experiments, he better appreciated the role of predators. Pak Oyo was so inspired by what he learnt that he decided to enroll at that as a farmer trainer, and the training developed his capacity for innovation and creativity. This further inspired him to look seriously at rice ecology.
>
> Pak Oyo has a farm in his village of Buah Dua, a village dependent on rice cultivation for its economy. One morning three seasons ago

(in March 1996), while caring for a rice nursery, he saw a large number of dragonflies hovering over the young rice seedlings. Pak Oyo remembered from his training and the FFS that dragonflies are predators. Indeed, he observed some dragonflies capturing Brown Planthoppers (BPH) as these flew from the nursery as Pak Oyo worked in it. He was excited by what he saw. Looking around, he noticed some dragonflies resting on bamboo markers next to the nursery.

Pak Oyo thought hard and long about what he had seen in the nursery. It dawned upon him that if dragonflies could be encouraged to stay in the rice field, they would protect his crop from insects. He was concerned about the normal practice of spraying insecticides to prevent BPH outbreaks. Pak Oyo was convinced that spraying insecticides had led to several outbreaks of this insect in the village. Encouraging dragonflies in the field could possibly reduce the number of BPH coming into and flying out of the field.

He planned a small experiment to see if dragonflies could be encouraged to stay in a field planted with markers. Initially he used only six bamboo markers placed around the field for two weeks. Regular observations showed that dragonflies frequently rested on the markers and this encouraged Pak Oyo to expand this study. He placed more bamboo markers all around his field and he noticed that throughout the season there was no build-up of BPH in his crop, whereas neighboring fields subjected to insecticide sprays had large populations of BPH. He talked to his friends in the village about his results and they decided to join him in the experiment and the topic was included in a FFS organized by Pak Oyo. In the next two seasons, farmers who placed bamboo markers in their fields did not have any problem with BPH. In the coming season (1997/98), up to 40 ha of rice fields will be planted with bamboo markers and farmers are confident that they will not need to apply insecticides.

Dragonflies are familiar insects in the community. Children play with captured adults by tying thread to the abdomen and watching them attempt to fly away. Children were warned about wetting the bed for if they continue to do so, the parents will catch a large dragonfly (possibly *Orthethrum sabina*) which will bite their navel. According to farmers in the village, this is a successful way to stop children from wetting their beds.

Rice farmers knew the life cycle of the dragonflies in the rice field. Part of this came from their greater interest in the insect during FFS. However, most of the information came from their gastronomic knowledge. Apparently, larvae of dragonflies (kini-kini) are eaten as food, particularly by women. These are collected when women weed the rice field. Kini-kini are considered delicacies by the women folk. These are either fried or mixed with herbs and steamed wrapped in a banana leaf.

There appeared to be a conflict between the women and men in the village. While the men found that dragonflies are good natural enemies, the women are removing them just as fast in the larval stage. Pak Oyo organized a field school especially for women in the villages to educate them about natural enemies, including dragonflies. This would help women in the village to value the dragonfly nymphs.

Pak Oyo and his friends also reported that some conditions affect the well being of dragonflies in the rice field. The use of insecticides such as carbofuran will kill off the kini-kini and this will reduce the number of dragonflies. In addition, they found that when rice fields are drained, for example to manage rats, the population of kini-kini will decline too. Both observations were confirmed in studies conducted by farmers in Boyolali and Indramayu.

It has been suggested by some biological control specialists that dragonflies may not be all that important in controlling BPH. This is probably true, as BPH concentrates near the base of rice plants. However, dragonflies will probably remove the arriving and departing macropterous (5) adults. However, a better way of looking at this issue is to consider that encouraging dragonflies is to encourage a whole community of predators. When farmers put out markers for dragonflies instead of spraying insecticides, this means that important predators of BPH, such as the Wolf Spider, *Lycosa pseudoannulata*, are conserved. Hence, the approach to help farmers better understand biodiversity and promote conservation would encourage more innovative ways of appreciating biological control (Ooi, 1998).

Mina-Padi a Mutually Beneficial Ecosystem

Mina-Padi farming system of combining rice-cropping with fish-rearing is based on the fact that the rice crop environment with plenty of water can be a perfect environment benefiting the growth of the fish raised in the rice field.

In mina-padi farming system farmers create a mutually beneficial relationship between their rice crops and the fish they raise. These way farmers can save and lower their cost of the production and at the same time double their income and become independent of externally supplied agricultural inputs.

Name or Title of Practice/Project
Mina-Padi: Rice Cropping Combined With Fish Rearing

The Purpose or Beneficial Uses
This combination of two farming activities could generated a double income to the farmer

What Are the Materials or Ingredients Needed

1. Flooded rice field: irrigation water available for the whole cropping season of local rice. Some of the local rice variety matures in 150 days.
2. Water should be clean, no pesticides pollution is allowed as it will kill the fish. Talk to your neighbor about this plan. It would be best if the whole area to practice this Mina-padi or at least agree not to use any pesticides. This includes some natural pesticides as well.

How to Prepare the Rice field

- Using traditional land preparation techniques, farmers make the field ready for traditional rice cropping. In this case land prepared using draft animals is preferable to using a hand-tractor. This guaranteed there won't be any oil spill in the rice field.
- Use of heirloom or local rice, which can florish without the use of inorganic fertilizer or the application of chemical pesticides.
- The farmer must irrigate the rice field so there is enough water for rearing the fish, and he must make sure no pollutant gets in to this pool.

How Does It Work

- Newly hatched fish may now be put in this flooded rice field. Asian carp is raise here as it grow fast and has good market value.
- From this point on no chemicals application can be allowed in rice because it will poison the fish. The rice crop will create a good environment for fish rearing. Insects around the rice crop, their larvae and some algae, and small grass will become good sources for fish food.
- No chemical application will guarantee the balance or equilibrium of the ecosystem necessary for fish rearing and rice crops alike.
- Excretions of the fish become good nutrients for the rice crops; the fish eat the bad insects and consume insect larvae around the crop root system.
- Fish will be harvested three times during the rice cropping period:
    1. First harvest of fish when they reach fry size
    2. Second harvest when they reach fingerling size
    3. The final fish harvest when reach consumption size; the same time for the rice is ready for harvest as well.

Using 1000 meter square flooded rice field Mbah Suko made the following costs-benefits calculation as explained in the spreadsheet below. This calculation shows that income from the fish is 27% higher than from rice. Plus, farmers eat some of the harvested fish for family consumption.

Important Notes or Cautions:

Farmer need to make sure that there is no chemical contamination to the body of water where the rice field it water from.

Sources of Information

Mbah Suko farming experience, similar information is also explained in chapter 7.

Costs/Benefits Calculation of Mina-Padi per 1,000 square meters plot

Rice cropping			**Expenditures**	**Revenues**
Straw clearing from field	6 man/day @ Rp5,000		Rp30,000.00	
Seed bed preparation	1 man/day @ Rp5,000		Rp5,000.00	
Fix borders/Dikes	4 man/day @ Rp5,000		Rp20,000.00	
Heirloom Seed (Rojolele, Berlian)	5 Kgs @ Rp3,000		Rp15,000.00	
Manure	20 bushels @ Rp2,000		Rp40,000.00	
Natural pesticides	2 liters @ Rp5,000		Rp10,000.00	
Plowing	2 times @ Rp10,000		Rp20,000.00	
Harrowing	2 times @ Rp10,000		Rp20,000.00	
Transplanting	10 people @ Rp1,500		Rp15,000.00	
Weeding	2 times @ 10 people @ Rp1,500		Rp30,000.00	
Land tenure/rent	6 months		Rp300,000.00	
Other costs	food for laborers		Rp50,000.00	
additional manure	for second application		Rp25,000.00	
Total cost			Rp580,000.00	
Total harvest	450	kgs		
Harvester/worker share 1/8 of total harvest as payment	56.25	kgs		
Selling price	Rp2,500.00	/Kg		Rp984,375.00
Profits from rice-cropping				**Rp404,375.00**

Fish Rearing

Breeder Fish	10 heads @ Rp10,000	Rp100,000.00	
Fodder (rice bran)	10 kgs @ Rp1,000	Rp10,000.00	
First harvest at fry size 1-2 cm	15 cups @ Rp150,000		Rp150,000.00
Second harvest at Fingerling size 5-7 cm	10 kgs @ Rp25,000		Rp250,000.00
Third harvest at consumption size 15-20 cm	15 Kgs @ Rp15,000		Rp225,000.00
Total costs		Rp110,000.00	
Total Sales from Fish			Rp625,000.00
Profits from Fish-rearing			**Rp515,000.00**
Percentage of fish over rice increase			**127%**
Total profits			**Rp919,375.00**

Homemade Liquid Fertilizer

Name or Title of Practice/Project
Making Liquid Fertilizer from Leguminous Leaves

The Purpose or Beneficial Uses
Produce homemade nitrogen fertilizer from mix of leguminous tree leaves that cost almost nothing

What Are the Materials or Ingredients Needed
1. leaves of leguminous trees, which are rich in nitrogen such as:
    1. *dadap serep* (*Erythrina subumbrans*),
    2. *ketelo* or *Manioc suculenta* also known as Cassava,
    3. *Lamtoro gung* (*Leucaena leucochepalla*)
    4. *Gliricidia sepium* or Mexican lilacs.
2. Big plastic container for putting and fermenting the mix

How to Prepare the Ingredient or the Formula
1. Pound or grind the mixes of leaves. The amount of leaves needed depend on how much coverage will be needed.
2. Put the ground leaves mix in the big plastic container
3. Mix of ground leaves with 1 liters of cattle urine and 9 liter of water.
4. Cover the container and let it ferment for at least about 3 days. The longer the better as it would allow more of the leave ingredient to break down. It is recommended to let it ferment to 14 days.
5. After 14 days, the liquid can be extracted and filtered. Please use tight fabric for filtering and make sure no leaves debris get into the filtered liquid as it will clog the sprayer.

6. Put the filtered liquid in a clean container. This mix is now ready to use as natural liquid fertilizer.

How to Apply

1. Prepare spraying mixture by diluting 150-200 ml of liquid fertilizer with 15 liters of water.
2. Application of this liquid fertilizer is done using sprayer. Spraying is targeted to the crop's leaves.

How Does It Work

Liquid fertilizer made from leguminous tree leaves is actually a very high concentration of Nitrogen (N), the most needed nutrient for plant's vegetative growth. Fermentation process by adding cattle urine enhances the extraction of N from the leaves. Cattle urine also contains high concentration ammonia, another N compound. Allowing the liquid to ferment for about 14 days provide enough time for bacteria to decompose leaves component and make it a high concentration of Nitrogen.

Important Notes or Cautions:

Although most cattle disease is not transferable to humans, however, it suggested that handling this ingredient contains with cattle urine with some caution. Cattle disease like anthrax is known to be dangerous to humans as well.

- Use cattle urine from healthy cattle.
- Use Glove when mixing the ingredients
- Always wash hand after handling the ingredient

Sources of Information:

Interview with Mbah Slamet, Kebon Agung, Sleman, Central Java. He is one of the respondent farmers for this study.

APPENDIX D

LIST OF COMPANION PLANTING

Many agricultural communities around the world have traditionally known the concept of companion planting for centuries. Farmers observed their own practices and recorded their practices of companion planting for their crops. There are good companion plants and bad companion plants. Good companion plants will bring extra benefits such as repels pathogenic insects and their larvae that way they protect the main crop; it could also strengthen a certain flavor to fruit like tomato; for example lemon basil planted in companion with tomato will strengthen the tomato flavor, or if foxglove is grown near tomato it increases the tomato 'keeping' quality. On the other hand bad companion plants will bring negative effects. Black walnut for example is enemy to most other plants, including but not limited to: apples, azaleas, lilac, magnolia, mountain laurel, peas, peony, peppers, potatoes, rhododendron, sugar maple, tomatoes. Below, I put three related tables about companion planting I found from the web, http://www.moonsweb.com/companions.shtml. The name of the real author was not clear. The first table explains about good and bad companion plants and shows what bad insects they repel or good insect they might attract. The second shows the list of trees that are cautioned to be enemies to certain crops and finally the last lists the bad insects and what plants repel them. I found these tables are very functional to indigenous farmers. They seemed were created based on western or pagan indigenous farming community experiences, but I believe they would be good guide to rest of the world.

Companion Planting

Companion planting is based on the idea that certain plants can benefit others when planted in near proximity so that some cultural benefit (pest control, higher yield, etc.) is derived. Shallow-rooted plants next to deeply-rooted ones won't compete for water. Shade-loving plants living in the shadows of taller sun-lovers aren't competing for sunlight, and short bushy plants will often live happily next to taller, leaner plants. Some plants will attract bad insects away from the plants you wish to protect or even attract beneficial insects to your garden, while some repel bad insects or encourage & help each other to grow. There are also some plants should never be planted next to one another because the substances they produce can be toxic and may hinder the growth or production of fruits and flowers to the others.

These sets of three tables were downloaded from the internet written by the moonsweb.com website owner. The original web document can be found in the following link: http://www.moonsweb.com/companions.shtml

For me part of the Pagan path is working within nature. Companion Planting is one of many ways to do this.

Below is a list of vegetables, herbs, flowers and wild plants and a few details about growing each. This is only a general guideline, experiment in your own garden to see what works best for you, these may give great results for one person and none for another, for example you can not attract insects that are not native to your location. Keep notes on your results and use them to modify your garden next year.

Herb	Good Companions	Bad Companions	Pests Repelled	Attracts these beneficial insects
Alfalfa	.		.	Parasitic Wasps (Cotesia medicaginis, Braconid Wasp), Lady Beetles, Damsel bugs, Big-Eyed Bugs, Assassin Bugs
Angelica- Angelica Archangelica		Avoid Dill	.	Lacewings, Lady Beetles, Parasitic Wasps

Herb	Good Companions	Bad Companions	Pests Repelled	Attracts these beneficial insects
Anise	Plant with coriander, which promotes its germination and growth, potatoes		Slightly repels Imported Cabbage Worm	Parasitic wasps
Asters	Most Crops		Most insects	Honeybees, Lichneumonid Wasps
Barberry		Wheat, Rye	.	.
Basil	Asparagus, Pepper, Tomato, Marigold,	Rue	Flies, Mosquitoes, Hornworm	Honeybees
Beans (Pole)	Carrots, Corn, Celery, Cucumber, Eggplant, Lettuce, Pea, Radish, Savory, Tansy,	Onion, Beets, Kohlrabi, Sunflower, Cabbage family	.	.
Beebalm	Tomato		.	.
Beets	Bush Beans, Cabbage family, Corn, Leek, Radish, Onion, Sage,	pole beans, mustard	.	.
Borage	Tomatoes, Squash, Strawberries		Tomato Worm, Hornworm	Honeybees
Buckwheat	.		.	Syrphid Flies
Bush Beans	Beets, Cabbage, Carrots, Celery, Corn, Cucumbers, Eggplant, Lettuce, Pea, Radish, Strawberry, Savory, Tansy, Marigold,	Onion, Fennel	.	.
Cabbage Family	Aromatic Herbs, Celery, Onion Family, Chamomile, Spinach, Chard, Bush Beans, Beets, Tomato, Sage, Pennyroyal, Mints, Oregano, Parsley, Marigold, Nasturtium,	Dill, Strawberries, Pole Beans, Tomato	.	.
Calendula	Most Crops		Good all-purpose insect repellent	.
Candytuft	.		.	Syrphid Flies
Caraway	Most Crops I	.Avoid Dill, Carrots	.	Parasitic Wasps

Herb	Good Companions	Bad Companions	Pests Repelled	Attracts these beneficial insects
Carrots	Bush Beans, Pole Beans, Peas, Radish, Tomato, Sage, Lettuce, Rosemary, Onion Family, Feverfew,	Dill, Parsnips, caraway	.	Parasitic Wasps (Cotesia medicaginis, Braconid Wasp), Lacewings, Big-Eyed Bugs, Assassin Bugs
Castor Bean	.		Mole and Plant Lice	.
Catnip	Eggplant		Flea Beetle, Ants, Green Peach Aphids, Squash Bugs, Cucumber Beetles	Bees, Parasitic Wasps
Celery	Bush Beans, Spinach, Onion & Cabbage Families, Tomato, Nasturtium		White Cabbage Butterfly	.
Chamomile	Cabbage, Onion		.	.
Chervil	Radish (makes them very hot)		.	.
Chicory	Pea		..	..
Chives	Carrots		Rust fly, nematodes	..
Chrysanthemu m	.		good all purpose insect repellent	.
Coreopsis	.		Many insects	.
Coriander	Anise		Aphids, most insects	Tachinid Flies (they feed on cut worm larva)
Corn	Bush Beans, Pole Beans, Cucumber, Melons, Peas, Squash, Pumpkins, Peas, Potatoes,	Tomato	.	.
Corn spurry - Spergula arvensis	.		Caterpillars, Aphids, Rootworms	Predators and parasites of cabbage pests
Cosmos		Fennel	Many insects	.

Herb	Good Companions	Bad Companions	Pests Repelled	Attracts these beneficial insects
Cucumbers	Bush Beans, Pole Beans, Corn, Lettuce, Onions, Peas, Radish, Sunflowers, Marigold, Nasturtium, Savory,	Irish Potato, Aromatic Herbs, Peppers	.	.
Dandelion	.		Colorado Potatoe Beetle	Pollen for Lacewings, Lady Beetles and other predators
Datura	.		Japanese Beetles	.
Dead Nettle	Potatoes		Potato Bug	.
Dill		Dislikes Carrots and Caraway	Aphids, Spider Mites	Aphids predators and parasites
Eggplant	Bush Beans, Pole Beans, Spinach, Tarragon, Thyme, Peas, Garlic		Colorado Potato Beetle	.
Fennel		Coriander, (Most plants dislike this herb)	.	Hover Flies, Syrphid Flies, Parasitic Wasps, Tachinid Flies
Feverfew	Roses		attracts Aphids away from roses	.
Flax	Carrot, Potato		Potato Bug	.
Foxglove	Grown near tomato increases the tomato 'keeping' quality		.	.
Garlic	Roses, Cabbage, Brocolli, Brussels sprouts, Cauliflower, Collard, Kale, Tomatoes, Eggplant, Fruit trees, Raspberries (Plant garlic or garlic chives around anything and everything but beans & peas)	Beans, Peas	Japanese Beetles, Fruit Tree borer, Aphids and blight, Weevils, Spider Mites	.

Herb	Good Companions	Bad Companions	Pests Repelled	Attracts these beneficial insects
Geranium	Roses		Another all-purpose insect repellent, trap for Japanese Beetles	.
Goldenrod		Sugar Maples, Black Locust	.	Honeybees, Lacewings, Minute Pirate Bugs, Soldier Beetles, Spiders, Parasitic Wasps (Cotesia medicaginis, Braconid Wasp), Lady Beetles, Big-Eyed Bugs, Assassin Bugs
Hawthorn	.		.	Winter host of parasite of Diamond-back Moth
Henbit	.		General Insect Repellent	.
Horehound	.		.	Tachinid Flies, Syrphid Flies (larva eat Aphids)
Horseradish	Potatoes		Potato Bug	.
Hyssop	Cabbage, Grapes,	Radishes	Cabbage Moth, trap for White Cabbage Butterfly	Honeybees
Ivy - Hedera spp.	.		.	Hover flies, Tachinid Flies
Lamb's Quarters	Corn, most crops		.	.
Larkspur	Beans, Cabbage, Oats,	Beets, Carrots, Parsnips, Turnips	.	.
Lavender	..		Moths (combine with southernwood, wormwood and rosemary in an anti-moth sachet) deters most pests when planted in the garden	.
Lemon Balm	Most crops		.	Honeybees

Herb	Good Companions	Bad Companions	Pests Repelled	Attracts these beneficial insects
Lemon Basil	improves taste of tomatoes		deters Whiteflies	.
Lettuce	Bush Beans, Pole Beans, Carrots, Cucumbers, Onion, Cabbage, Radish, Spinach, Strawberries (grows especially well with onions),	Garden Mums, Brocolli, Barley, Rye, Wheat, Fava beans,	.	.
Lily of the Valley	Grown near tomato increases the tomato 'keeping' quality		.	.
Lovage	Plant here and there to improve the health and flavor of other plants	Rhubarb	.	.
Marigolds	Bean, Potato, Rose, Tomato, Most crops,	Many weeds	Mexican Bean Beetles, Colorado Potatoe Beetles, Root nematodes, Whitefly, Aphids, Slugs, BEST all-purpose insect repellent. Scatter marigold all around your garden and yard to repel many different insect pests	Hover flies
Marjoram	Sage, Peppers		Most insects	Honeybees
Melons	Corn, Nasturtium, Radish		.	.
Mint (spearmint, pennyroyal)	Cabbage, Tomatoes		White Cabbage Moth, Cabbage Maggot, Mosqitoes, Aphids, Ants, Flea Beetle, Plant Lices	Honeybees
Mole Plant (a species of Euphorbia)	.		Moles and Mice	.
Morning Glory	Corn, Melon,	Apricots	.	Lady Beetles, Syrphid Flies

Herb	Good Companions	Bad Companions	Pests Repelled	Attracts these beneficial insects
Mustards	.		Aphids from neighboring brussel sprouts and collards	flowers attract parasites, especially of Cabbage Worms
Nasturtium	Radishes, Cabbage family, Cucurbits, fruit trees		Aphids, Squash Bugs, Striped Pumpkin Beetle, Whitefly, Sooly Aphid, Slightly repels Colorado Potato Beetle	.
Onion	Beets, Cabbage, Carrots, Celery, Cucumber, Lettuce, Pepper, Squash, Strawberries, Tomato, Savory,	Bush Beans, Pole Beans, Peas (Beans and onions are natural enemies)	.	.
Oregano	Cabbage, good companion for all plants		Most insects	.
Parsley	Tomato, Asparagus, Corn, Roses, Celery, Leek, Peas		.	.
Peas	Bush Beans, Pole Beans, Carrots, Corn Cucumber, Radish, Turnips, Radishes, Potatoes, Aromatic herbs,	Gladiolus, Irish Potato, Onions, Garlic, Leek, Chives, Shallots	.	.
Pennyroyal	Roses		Flies, Mosquitoes, Fleas, others	.
Pepper	Onion		.	.
Peppermint	Cabbage		White Cabbage Butterfly, Ants	.
Petunia	Beans, Potatoes,	Apricots	Beetles	.
Pigweed	Corn, Onion, Potato		.	.
Pot Marigold	Tomatoes, Most crops		Tomato Worm, Asparagus Beetles, others	.
Potato, Irish	Beans, Corn, Cabbage Family, Marigolds, Horseradish,	Pumpkin, Squash, Tomato, Cucumber, Sunflower, Eggplant	.	.

Herb	Good Companions	Bad Companions	Pests Repelled	Attracts these beneficial insects
Pumpkins	Corn, Radish, Marigold,	Irish Potato	.	.
Purslane	under corn as a ground cover		.	.
Pyrethrums	.		Pickleworms, aphids, Leafhoppers, spider mites, harlequin bugs, Imported Cabbage Worms, Ticks. Use dried flower heads as a general insect repellent.	.
Queen-Anne's Lace	.		.	Many parasitic Wasps and Flies, Hover Flies, Japanese Beetle parasites, Lady Beetles,Minute Pirate Bugs
Radish	Kale, Collard, Tomatoes, Peas, Onions, Carrots, Chervil, Bush Beans, Pole Beans, Carrots, Cucumber, Lettuce, Melons, Peas, Squash, Beets, Spinach, Parsnips (It's said that summer planting near leaf lettuce makes the radishes more tender)	Hyssop, Cabbage, Cauliflower, Brussels Sprouts, Broccoli, Kohlrabi, Turnips, Grapes	Cucumber Beetle	.
Rosemary	Cabbage, Beans Carrots, Sage, Brocolli,Brussels sprouts, Cauliflower, Collard, Kale		Cabbage Moth, Bean Beetle, Carrot Fly, Malaria Mosquitoes	.
Rue	Roses and Raspberries,	Cabbage, Brocolli, Brussels sprouts, Cauliflower, Collard, Kkale, Basil, Sage	Japanese Beetles	.
Rye		Barberry	.	Rove Beetles

Herb	Good Companions	Bad Companions	Pests Repelled	Attracts these beneficial insects
Sage		Cucumbers, Rue	Cabbage Moth, Carrot Fly, Flea Beetle, Slugs, Ticks	.
Santolina	.		Moths	.
Sassafras	.		Plant Llice	.
Scorpion Weeds - Phacelia spp.	.		.	Honeybees, numerous parasitic Wasps, Tachnid Flies
Shoo-fly Nicanda Physalodes	.		.	attracts and kills Whiteflies
Southernwood	Cabbages		Cabbage Moth, Flea Beetles, Malaria Mosquitoes	.
Sowthistle		Plant in moderation	.	.
Soybeans	.		(grown to shade the bases of the plants) Cinch bugs and flea beetles.	.
Spinach	Celery, Eggplant, Cauliflower		.	.
Spiny amaranth	.		.	Black Cutworms
Squash	Onion, Radish, Nasturtium, Corn, Marigold, Icicle radishes, Cucumbers,	Irish Potato	.	.
Strawberry	Bush Beans, Lettuce, Onion, Spinach, Peas,	Cabbage family	.	..
Stinging nettle	Grow near aromatic herbs, increases aromatic oil up to 80%		.	alternate hosts of Aphid predators
Summer Savory	Plant with beans and onions to improve growth and flavor.		Bean Beetles	.

Herb	Good Companions	Bad Companions	Pests Repelled	Attracts these beneficial insects
Sunflowers	Beans, Corn, Squash, Cucumber,	Potatoes, Pole Beans		
Sweet Clover Melilotus alba	.		.	Honeybees, Tachinid Fly parasites of many catapillars.
Tarragon	Eggplant, Good companion to most vegetables		.	.
Tansy	Fruit Trees, Roses, Raspberries, Blackberries, Peppers, Potatoes, Squash		Flying Insects, Japanese Beetles, Striped Cucumber Beetles, Squash Bugs, Ants, Flies	Imported Cabbage Worms
Thyme	Cabbage, Cabbage, Brocolli, Brussels sprouts, Cauliflower, Collard, Kale, Eggplant		Cabbage Worm	.
Tomato	Parsley, Marigolds. Lettuce, Carrots, Celery, Mint, Onion Family, Basils, Nasturtium, Asparagus, Goose berry, Cucumber,	Corn, Irish Potato, Apricot Trees, Fennel, Dill, Cabbage Family, Eggplant, Peppers, kohlrabi. Don't plant tomatoes near nut trees such as pecan, walnut or hickory (tree roots secrete a phytotoxin that is toxic to tomatoes).	Asparagus Beetle	.
Turnip	English Pea,	Irish Potato, Delphinium, Larkspur	.	.
White clover	.		Cabbage root flies	Tachinid Flies, Parasites of Aphids and Cabbage Worms, shelters Ground Beetles, Spiders, Parasitic Wasps (Cotesia medicaginis, Braconid Wasp)

Herb	Good Companions	Bad Companions	Pests Repelled	Attracts these beneficial insects
Wormwood	Best kept from most plants, but wonderful as a border to repel pests		Plant as a border to keep animals out of the garden Repels Flea beetles on cabbage, Malaria Mosquitoes, (dried & crushed to a dust & sprinkled on plants and the soil will deter many insects)	.
Yarrow	Plant near aromatic herbs to enhance production of essential oils.		.	Hover Flies, Lady Beetles, Parasitic Wasps (Cotesia medicaginis, Braconid Wasp),

Trees	Enemy to
Apple	potatoes, hawthorn
Apricot	plums, potatoes, eggplant, tomatoes, petunias, nicotiana, morning glory
Black Locust	goldenrod
Black Walnut	Enemy to most other plants, including but not limited to: apples, azaleas, lilac, magnolia, mountain laurel, peas, peony, peppers, potatoes, rhododendron, sugar maple, tomatoes
Hawthorn	apples
Pear	potatoes
Sugar Maple	goldenrod
White Pine	currants, gooseberries

Insect	Plant that repels it
Ants	pennyroyal, spearmint, southernwood, tansy, marjoram, mint family, oregano, onions, rue
Aphids	garlic, chives, and other allium, coriander, anise, nasturtium and petunia around fruit trees, chives, marigolds, mint gamily, dried & crushed chrysanthemum flowers, coriander, oregano
Borer	garlic, onion, tansy
Cabbage Moth	mint, hyssop, rosemary, southernwood, thyme, sage, wormwood, celery, catnip, nasturtium
Cabbage Worms	tomatoes, celery
Carrot Flies	leeks, sage, rosemary
Colorado Potato Beetle	green beans, horseradish, dead nettle, flax, catnip, coriander, tansy, nasturtium, marigolds
Cucumber Beetle	tansy, radish, Nasturtiums
Cutworm	tansy
Flea Beetle	wormwood, mint, catnip, garlic
Flies	basil, tansy
Japanese Beetle	garlic, larkspur, tansy, rue, white geranium
Leafhopper	petunia, geranium, dried & crushed chrysanthemum flowers
Mexican bean beetle	marigold, potato, rosemary, summer savory, petunia
Mites	onion, garlic, chives
Mosquitoes	basil, garlic, geranium (citrosa)
Nematodes	marigold, salvia, dahlia, calendula, asparagus
Onion flies	garlic
Rose Chafer	geranium, petunia, onion
Slug	prostrate rosemary, wormwood
Squash bug	tansy, nasturtium, catnip
Ticks	garlic
Tomato Hornworm	borage, marigold, opal basal
Whitefly	nasturtium, marigold, oregano

Another List of Companion Plant

The following table shows the similar concepts of companion plants collected from different source. These lists could supplement one another. They were written differently and believed were collected from different sources. Again, the main concept of companion plants is used to confuse or repel plant pests, or to encourage the growth of other plants and to act as a trap for pests and parasites. There are also plants that "trap" harmful insects away from the plants you are trying to grow. So these plants act as attractant and keep the insect happy away from the main crops.

Some Companion plants may also be supplier of nutrients to other crops. Many leguminous plants such as beans and peanut provide abundant nitrogen (N) needed for plant vegetative growth. Companion plants may produce odors that confuse and deter pests, or their scent may mask or hide a crop from pests. The original table is from Garden Toad's Companion Plant Guides found from the following link: http://www.gardentoad.com/companionplants.html

The Table below Lists Some Commonly Held Beliefs about the Uses of Companion Plants

Plant Name	Companion to:	What It Is Believed To Do (Good & Bad)
Allium--flowering onions, chives, garlic, leek, onion and shallot	Roses, carrots, tomato, fruit trees, other vegetables	Repels aphids, weevils, carrot flies, moles, fruit tree borers; controls rust flies and some nematodes; protects tomatoes against red spiders. Protects roses from black spot, mildew and aphids. BUT is believed to inhibit growth of peas & beans.

Plant Name	Companion to:	What It Is Believed To Do (Good & Bad)
Basil	Tomato, asparagus	Repels aphids, flies, mosquitos and mites; helps control insect pests such as tomato hornworms, asparagus beetles, and disease.
Bush beans (Butter, green, snap, string,wax)	Beets, carrots,cucumber, corn, eggplant, potato,strawberry	Encourages growth of companion plant. Adds nitrogen to the soil. Green beans protect eggplant from the Colorado potato beetle.
Borage	Tomato, strawberry, fruit orchards	Repels tomato worms. Adds potassium, calcium and other minerals to soil. Attracts honeybees.
Broad beans	Corn	Add nitrogen to soil--which is needed by corn. Bean vines grow up corn stalks, thus anchoring corn more firmly and the vines discourage racoons.
Chamomile	Cabbage, onions	Improves growth and flavor--but plant only one plant every 150 feet or so.
Castor Bean	Vegetables	Repels moles and plant lice. CAUTION: All parts of the castor bean plant are poisonous, especially the seeds!
Catnip	Eggplant	Fresh catnip steeped in water and sprinkled on plants will drive away flea beetles.
Celery	Cabbage, leeks, tomato, cauliflower	Improves growth of companion plants. Repels white cabbage butterflies.
Chervil	Radish	Improves growth and flavor.
Chive	Carrots	Improves growth and flavor.
Coriander	Vegetables	Repels aphids. Attracts bees.
Cucumber	Corn, beans, peas, radish, sunflowers	Improves growth. Vines growing with corn help anchor corn and discourage racoons.
Datura	Various plants	Deters Japanese beetles. CAUTION: All parts of the Datura plant are poisonous!
Dill	Cabbage	Improves growth. Blossoms attract honeybees.
Fennel		Most plants dislike fennel--so plant it away from the vegetable garden. Its foliage and flowers may attract beneficials.
Geranium	Cabbage, cron, grapes, roses	Repels cabbage worms, Japanese beetles.
Horseradish	Potato	Encourages growth. May repel Colorado potato beetles and blister beetles.
Hyssop	Cabbage, grapes	Improves growth, deters cabbage moth.
Leek	Carrots, celery, onions	Improves growth, repels carrot flies.

Plant Name	Companion to:	What It Is Believed To Do (Good & Bad)
Marigold	Tomato, potato, strawberry, beans, roses	Encourages growth, deters Mexican bean beetles and other pests.. Discourages harmful nematodes, if they are grown for several seasons in the ground in areas that have nematode infestations.
Mint	Tomato, cabbage	Improves flavor and growth
Mustard	Cabbage, cauliflower, radish, Brussels sprouts, turnips, collards, kohlrabi	Plant mustard as a trap crop. It attracts numerous insect pests. Remove and destroy it before your main crops can be harmed.
Nasturtiums	Cucumber, Squash, other vegetables, fruit trees.	Repels aphids,cucumber beetles,whiteflies and squash bugs. Acts as trap crop for aphids. Repels borers near fruit trees.
Onion	Cabbage, cauliflower, broccoli,beets, tomato, lettuce, strawberry, chamomile, summer savory	Repels aphids, weevils, carrot flies, moles, fruit tree borers; controls rust flies and some nematodes; protects tomatoes against red spiders. BUT is believed to inhibit growth of peas & beans.
Oregano	Broccoli	Repels cabbage butterfly.
Parsley	Asparagus carrots, tomato, roses.	Deters asparagus beetles. Improves growth. Deters carrot flies and rose beetles.
Peanuts	Corn, squash	Encourages growth of corn and squash.
Peas	Corn	Adds nitrogen to soil for use by hungry corn plants. Grows well with carrots, turnip, radish, cucumber, beans and potatoes.
Peanut	Various plants	Excellent soil builder. Can make a good ground cover in a nut tree orchard.
Pennyroyal	Broccoli, Brussels sprouts, cabbage, other plants.	Discourages ants, plant lice, cabbage maggots.
Pyrethrum	Various plants	Repels aphids, leafhoppers, spider mites, harlequin bugs, ticks, pickleworms and imported cabbage worms.
Radish	Cucumber	Deters cucumber beetles.
Rosemary	Carrots, cabbage, beans	Repels carrot flies, bean beetles, cabbage moths.
Rue	Roses, raspberries	Repels Japanese beetles.
Sage	Carrots, various	Repels carrot flies, cabbage moths, ticks.
Snap beans	Corn	Enhances growth of corn.

Plant Name	Companion to:	What It Is Believed To Do (Good & Bad)
Soybeans	Corn	Enhances growth of corn and other heavy feeders by adding nitrogen to the soil. Repels chinch bugs and Japanese beetels.
Spearmint	Various plants	Deters ants, aphids.
Sweet pepper	Basil, okra	Improves growth.
Summer savory	Green beans	Improves growth, deters bean beetles.
Tansy	Cucumber, squash, roses, grapes, raspberry, blackberry.	Deters flying insects, striped cucumber beetles, ants, flies, squash bugs and Japanese beetles. BUT, attracts imported cabbageworms.
Toads (Okay, toads aren't plants--but they sure make the greatest companions to many plants.)	Various plants	One toad may eat as many as 10-thousand insects in a three-month period! Insects on toad's menu include cutworms, crickets, grubs, rose chafers, rose beetles, caterpillars, ants, squash bugs, sow bugs, potato beetles, moths, mosquitos, flies, slugs and even moles.
Tomato	Roses	Protects roses from black spot.
Thyme	Cabbage	Controls flea beetles, cabbage maggots, imported cabbageworms and white cabbage butterflies.
Walnut, Black		Black walnut trees inhibit the growth of apples, potato, tomato, blackberry.
Wormwood	Various plants	Deters black flea beetles, malaria mosquitos, cabbage worm butterflies.

Plant Name	Beneficial Insects It Attracts
Achillea spp. (Yarrow)	Honeybee, hover fly, parasitic wasp, ladybug
Alfalfa	Ladybug, assassin bug, bigeyed bug, damselfly
Aster (Aster)	Honeybee, spiders
Angelica archangelica (Angelica)	Lacewing, ladybug
Borago officinalis (Borage)	Honeybee
Cosmos bipinnatus (Cosmos)	Praying mantis
Hydrangea arborescens (Hydrangea)	Soldier beetle
Iberis spp. (Candytuft)	Syrphid fly
Ipomoea purpurea (Morning Glory)	Ladybug, syrphid fly
Monarda (Bee Balm)	Honeybee

Nemophila menziesii (Baby Blue-Eyes)	Syrphid fly
Nerium oleander (Oleander)	Lacewing, ladybug, parasitic wasp, assassin bug, syrphid fly
Oenothera biennis (Evening Primrose)	Ground beetle
Solidago spp. (Goldenrod)	Ladybug, predaceous beetles, parasitic wasps, lacewing, honeybees assassin bug, spiders
Zinnia (Zinnia)	Honeybee

APPENDIX E

LIST OF LOCAL/HEIRLOOM RICE VARIETY COLLECTED BY MBAH SUKO

Listed below is all the heirloom rice varieties collected and preserved by Mbah Suko. He collected them mainly from the Central Java area. For some of the varieties on the list I have included specific descriptions. Other varieties are marked “no specific description”; meaning that the general or common characteristics listed above apply. These common characteristics also apply to all, unless stated otherwise.

List of all heirloom rice from Mbah Suko collection:

1. Betok	Good aromatic rice, red colored, long grain hair (glume), good for baby formula and toddler food.
2. Cere	White grain, white glume, semi-sticky when cooked.
3. Leri	Grain falls easily off the panicles, semi-sticky and soft when cooked.
4. Mentik	Good aroma, semi-sticky when cooked
5. Saodah	the plant looks like Leri, semi dwarf and stiff stem
6. Bulu	Dwarf plants, semi-sticky, regular aromatic.
7. Lare Angon	no specific description
8. Ketan Atom	Sticky rice when cooked
9. Saerah	Grains fall easily off the panicles
10. Mainai	no specific description
11. Joko Dolan	no specific description
12. Terong	no specific description

13. Dewi Sri	does not grow well on the slope or at a high elevation
14. Cempo Palembang	grains have no glume
15. Sarinah	no specific description
16. Ketam Hitam	Black or blackish stem color; Black Panicle; black colored grain, sticky when cooked
17. Ketan Godok	Sticky and good tasting when boiled
18. Sri Kuning	Good aromatic with a jackfruit flavored smell; mainly planted in the dry land, though it also grows well in a flooded field; Cooked rice is rather hard and grains are non sticky
19. Ketan Pelem	Yellow grains like the peel of yellow mango; this can be planted in dry land as well as in a flooded field.
20. Kalinyamat	no specific description
21. Roro Jonggrang	no specific description
22. Bagelen	no specific description
23. Berlian	no specific description
24. Kuwi	no specific description
25. Kretek	no specific description
26. Gropak	no specific description
27. Gropak	no specific description
28. Ketan Randu	rice is sticky when cooked
29. Ketan Kadilangu	rice is sticky when cooked
30. Pocung	no specific description
31. Saidjah	no specific description
32. Ketan Brondol	no specific description

33. Ketan Marhaen	rice is sticky when cooked
34. Melik (Jowo Melik)	Rice grain is black in color; is traditionally known for weight reducing properties and is popular among women.

Common Physical Characteristics of Heirloom Rice

Heirloom or local rice varieties have a number of common physical characteristics that can easily be identified by simply looking at the plants, the stems, the panicles and the grains themselves. They also have distinctive aromas, and levels of stickiness when cooked. The following are some common traits characterizing this heirloom rice:

- The plant body or stem is tall. Some grows taller than 1 meter
- Big stems
- Plant generates a fewer offspring or splits. Producing an average of 10 splits per plant or seed.
- Have long panicle stems
- White kernels
- When cooked, rice is semi-sticky
- Stays good for a longer time after being cooked, a quality that is highly preferred in the areas where people could not afford refrigeration.
- Taste is good, aromatic.
- Common rice aroma, mild
- Average maturity time is around 120 days
- Non-dependent on urea and other inorganic fertilizers; they grow better with compost and other natural fertilizers.

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